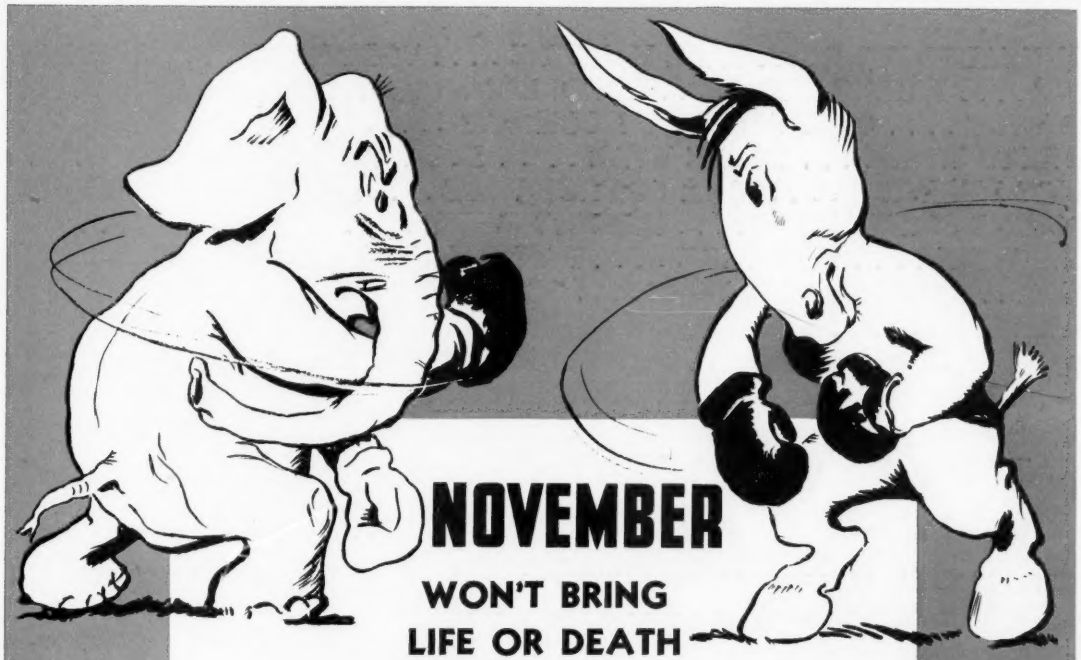
WIRE AND WIRE PRODUCTS

SEPTEMBER 1936

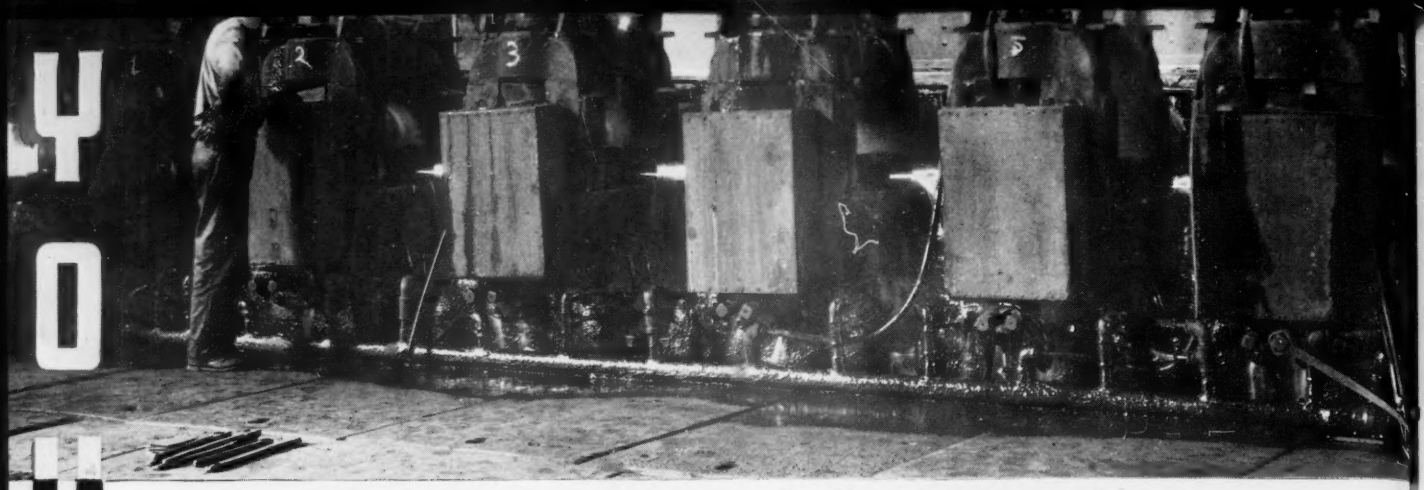


NOVEMBER
WON'T BRING
LIFE OR DEATH

Business will continue, no matter whom we elect, because we have a huge accumulated demand to satisfy. Taxes won't decrease, because we have big bills to pay. As a nation, our biggest problem will be to avoid foreign entanglements; as individuals, to keep our own houses cleanswept and efficient. In the latter category, Vaughn Engineers and Vaughn Machinery can help you—materially. Both are yours to command.

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO

Complete Drawing Equipment . . . Continuous or Single Hole for the Largest Bars . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or Their Alloys



Roughing stands in a continuous rod mill rolling rods to be drawn into wire

★IF NO ONE OF THESE WIRES LISTED BELOW MEETS YOUR PARTICULAR REQUIREMENTS, LET US KNOW . . . . our metallurgists have proved themselves able to develop highly specialized wires for a wide variety of uses.

★ANNEALED WIRE . . . . BALE TIE WIRE . . . . BOLT WIRE . . . . BOX BINDING WIRE . . . . BRIGHT WIRE . . . . BUNDLING WIRE . . . . CHAIN WIRE . . . . CRIMPING WIRE . . . . COAT AND HAT HOOK WIRE . . . . COPPERED WIRE . . . . GALVANIZED WIRE . . . . GRAPE WIRE . . . . HIGH CARBON SPRING WIRE . . . . HINGE PIN WIRE . . . . LIME COATED WIRE . . . . LIQUOR COATED WIRE . . . . MACHINE SCREW WIRE . . . . MARKET WIRE . . . . NAIL WIRE . . . . NOGALD BOLT WIRE . . . . NUT WIRE . . . . PAIL BAIL WIRE . . . . RIM WIRE . . . . RIVET WIRE . . . . SAE HEADING WIRE . . . . SCREW WIRE . . . . SCREW DRIVER WIRE SPOKE WIRE . . . . STAPLING WIRE . . . . STRAIGHTENED AND CUT WIRE STRAND WIRE . . . . WELDING WIRE . . . . WOOL WIRE X-TRUDO BOLT WIRE . . . . YOLOY WIRE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

General Offices - - YOUNGSTOWN, OHIO

SHEETS; PLATES; TUBULAR PRODUCTS; CONDUIT; TIN PLATE; BARS; RODS; WIRE; NAILS; UNIONS; TIE PLATES AND SPIKES

635

QUALITY TRADE MARK YOUNGSTOWN SERVICE

A battery of Youngstown wire drawing machines

YOUNGSTOWN

What has a MAZDA LAMP to do with Carboloy Dies?

It is a far cry from the Mazda lamps which you use in your office, plant, and home, to the Carboloy dies used in your plant for drawing and extruding of wire, bar and tubing. Yet there is a close bond—a bond of quality between the two. That bond is the tungsten used. The same high quality of tungsten which gives you dependable life in Mazda lamps is a basic ingredient of the Carboloy dies used in your plant. This high grade of tungsten in Carboloy tungsten carbide dies is a further assurance that you will receive maximum dependable results.

The Mark of CARBOLOY

CARBOLOY COMPANY, INC.
2985 E. Jefferson Avenue, Detroit, Michigan

Chicago Philadelphia Newark Cleveland Pittsburgh

Authorized Distributors: Hartley Wire Die Co., Waterbury, Conn. Canada: Canadian General Electric Co., Ltd., Toronto.

CARBOLOY REG. U.S. PAT. OFF. **DRAWING AND EXTRUSION DIES**

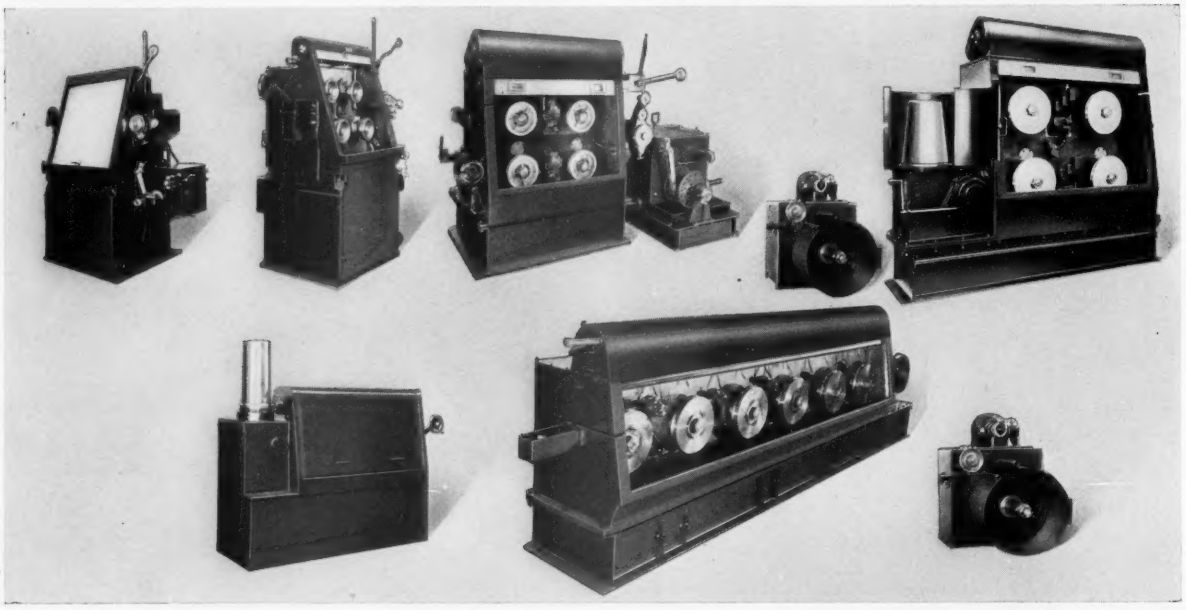
WIRE & WIRE PRODUCTS, Vol. 11, No. 9, September, 1936. Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

WIRE DRAWING EQUIPMENT

Manufactured By

ELEVATOR SUPPLIES COMPANY, Inc.

HOBOKEN, N. J.

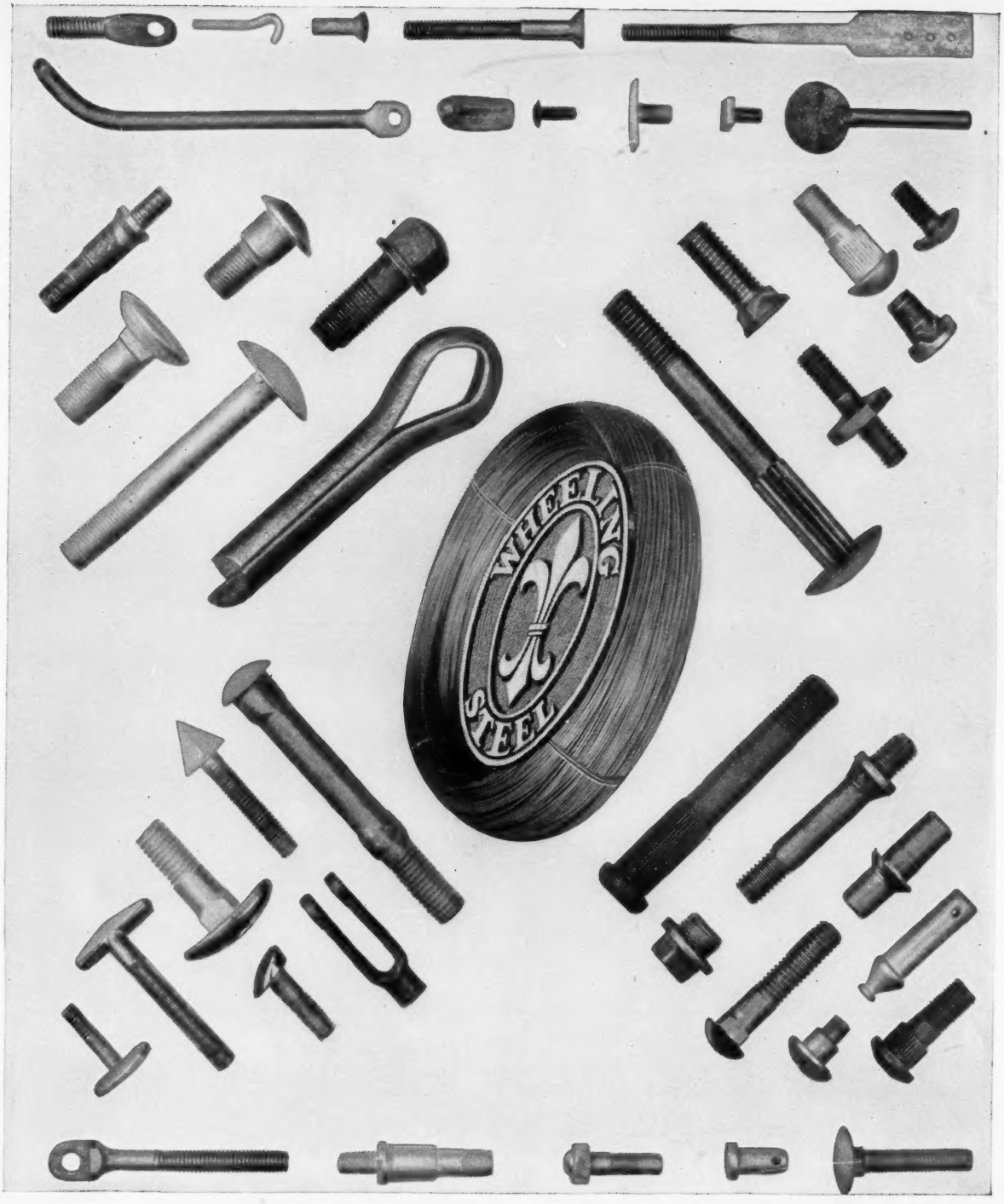


A complete line, minimum slip, wire drawing equipment built primarily for high speed wire drawing production. Liberal proportioning, anti-friction mounting, efficient power transmission, freedom from belts or chains, positive variable speed drive to spoolers to maintain uniform wire speed, accurate wire tension control at the point of spooling are a few of the features contributing to long life, efficient operation, economical production, clean and excellently wound quality wire.

Type of Machine	A	B	C	D	BB	F
With or without Spoolers	Yes	Yes	Yes	Yes	Yes	Yes
With or without Coiler	Yes	Yes	Yes	Yes	Yes	Yes
Size of finished wire B&S gauge	#34-#44	#26-34	#18-26	#12-22	#26-34	#2-#12
Number of Dies	16	16	12 or 13	13	13	5-7-9-11 or 13
Finished Wire Speed-FPM	5000	5000	4000	3500	2500 to 3500	2500 & 1000

Let us show you what our equipment can do towards cutting production cost and improving quality.

You are cordially invited to visit our Exhibit at The National Metal Congress, Booth 0-9 at Cleveland, Ohio, October 19 to 23 inclusive.



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IT'S WHEELING STEEL

"HUDCO" PRODUCTS...
Specially Processed Copper Wire...

▲▲▲ Electrolytic and Oxygen Free ▲▲▲

WIRE---
ESPECIALLY MADE FOR METALLIZING

Pure Lead
Lead Alloy
Pure Zinc
Zinc Alloy
Copper
Tin
High Brass
Low Brass
Solder Wire
Cadmium
Nickel Silver (10%, 18%, 30%)
Aluminum
Monel Metal
Phosphor Bronze
Pure Nickel
Commercial Bronze

"HUDCO" High Conductivity Electric Wire

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BRUSH WIRES, CRIMP and STRAIGHT
Brass, Steel, Nickel Silver, Copper and Phosphor Bronze

✦ ✦ ✦

TINSEL LAHNS
Silver Plated Copper, False Gold and Copper

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High Brass
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Zinc 99.99+ and High Tensile Zinc
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Phosphor Bronze
Pure Tin
Lead
Antimonial Lead
Cadmium
Nickel Silver, 10%, 18% and 30%
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False Gold and Special Brass and Bronze Alloys to Specification

Winco PRODUCTS Leakproof Enameled Wire

and enameled wires in all Standard and Special Covering ▲▲▲
Made to meet the most exacting requirements ▲▲▲
THE WINSTED DIVISION OF HUDSON WIRE COMPANY, WINSTED, CONN.

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Send in your specifications for a quotation.

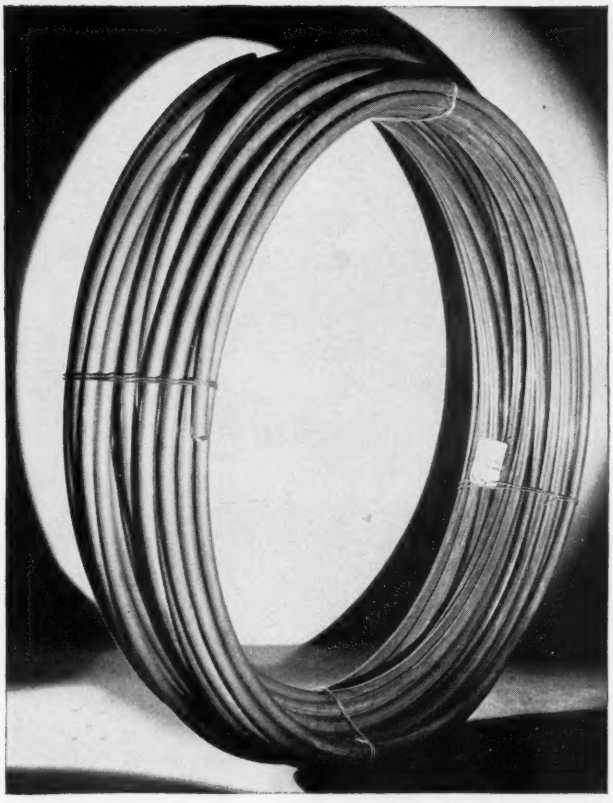
HUDSON WIRE COMPANY

Ossining, N. Y.

Estab. 1902 — Successors ROYLE & AKIN — Estab. 1902

for uniform high quality and prompt delivery

Specify



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FURNISHED IN THE FOLLOWING GRADES

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LOW CARBON RODS
HIGH CARBON RODS
SPRING WIRE RODS
WIRE ROPE RODS
FOUNDRY CORE RODS

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Special Analysis Rods in the following qualities: Special Cold Heading; Cold Forming Horse Nail; Electric Arc Welding; Gas Welding; Wood Screw; Screw Stock; Telephone; ENDURO Stainless Steel; Toncan Copper Molybdenum Iron.

•

Rods for the manufacture of wire for fencing, staples, barbed wire, twisted barbless wire, bale ties, poultry netting, hardware cloth, insect screen cloth and nails.

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Furnished as rolled, cleaned and lime coated, annealed or patented.

Too much thought cannot be given to your purchases of wire rods—for upon the quality of the rods depends the quality of your finished product.

Republic Wire Rods are made of new billet steel of known analysis. They are rolled on modern mills. They are remarkably free from slivers, laps and seams and show a minimum of surface scale.

The metal tag on a bundle of rods bearing the name REPUBLIC is assurance of uniform high quality. Size is accurate and plainly marked. Even the heat of steel from which the rods were made is recorded.

Republic Wire Rods may be had round, in coils, or straightened and cut to lengths up to 40 feet. Ends are trimmed to eliminate waste in manufacture.

Through its vast facilities, Republic is prepared to furnish quantities of rods to your specifications on short notice. Write for full information.

Republic Steel
CORPORATION

WIRE DIVISION . . . OFFICES AND PLANTS
7850 SOUTH CHICAGO AVENUE . . . CHICAGO, ILLINOIS
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REPUBLIC STEEL

VISIT THE REPUBLIC EXHIBIT AT THE GREAT LAKES EXPOSITION, CLEVELAND, OHIO, JUNE 27-OCT. 4.

The Time

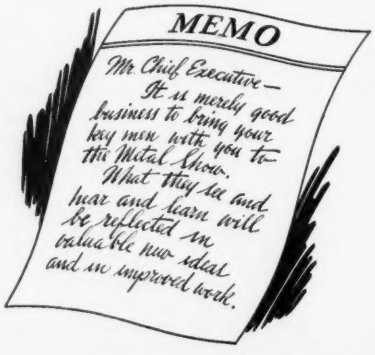
MONDAY THROUGH FRIDAY
OCTOBER 19 • 20 • 21 • 22 • 23

The Place

The huge Public Auditorium in Cleveland — the Heart of America's "Ruhr" — where ore and raw materials meet to be made into steel and automobiles and tires and a thousand articles for industrial and domestic use.

The Event

The eighteenth annual National Metal Congress and National Metal Exposition. Five great national societies will participate. You should be one of the many thousands of metal men to be on hand to hear more than a hundred technical and practical talks by metal experts . . . to see more than 225 exhibits of everything new and important in your industry . . . you'll meet old friends and make new ones . . . you'll exchange ideas with the men who, like yourself, are making metallurgical and engineering history. Don't fail to come, you owe it to yourself and your firm.



- Make your hotel reservations now and plan to attend.

- For complete details regarding programs & exhibitors write W. H. Eisenman, Managing Director, National Metal Congress & Exposition, 7016 Euclid Ave., Cleveland, Ohio

NATIONAL METAL SHOW

CLEVELAND, OHIO — PUBLIC AUDITORIUM — OCTOBER 19-23, 1936

COOPERATING SOCIETIES

AMERICAN SOCIETY FOR METALS — AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS — AMERICAN WELDING SOCIETY — THE WIRE ASSOCIATION

MEAKER

announces

the perfection and proving up of a process for

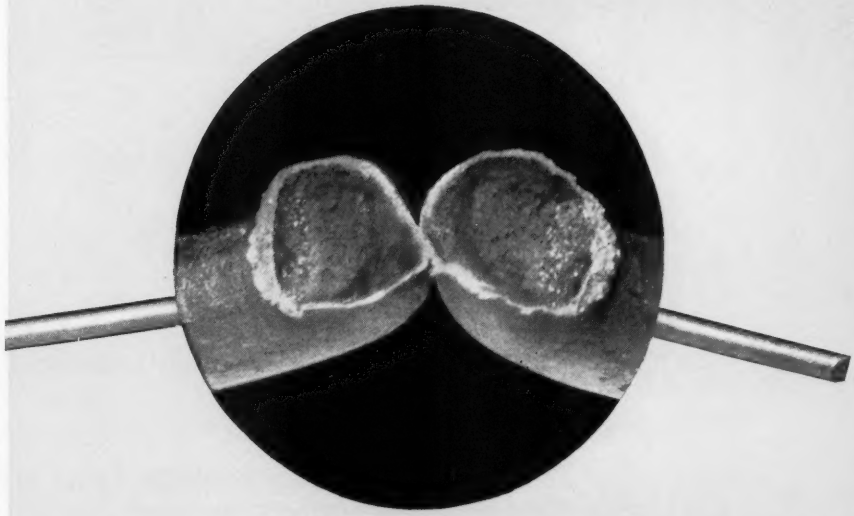
ELECTRO-GALVANIZING ROUND WIRE

which is producing commercially a coating superior by every test to any other now on the market.

This Process Provides:

- Simplified plant operation.
- Cost equal to or below hot-dip.
- Accurate control of coating thickness from 1/20 oz. to 3 oz. per sq. ft.
- Simplified cleaning operation that retains all original physical properties of wire unimpaired.
- High ductility and perfect adhesion, permitting even the most severe forming operations.
- Operation at high current densities producing extremely dense and non-porous coatings.
- Compact, simplified installation.

Backed by over thirty-seven years' engineering experience in solving electro-galvanizing problems for the industry. Wire or write for details.

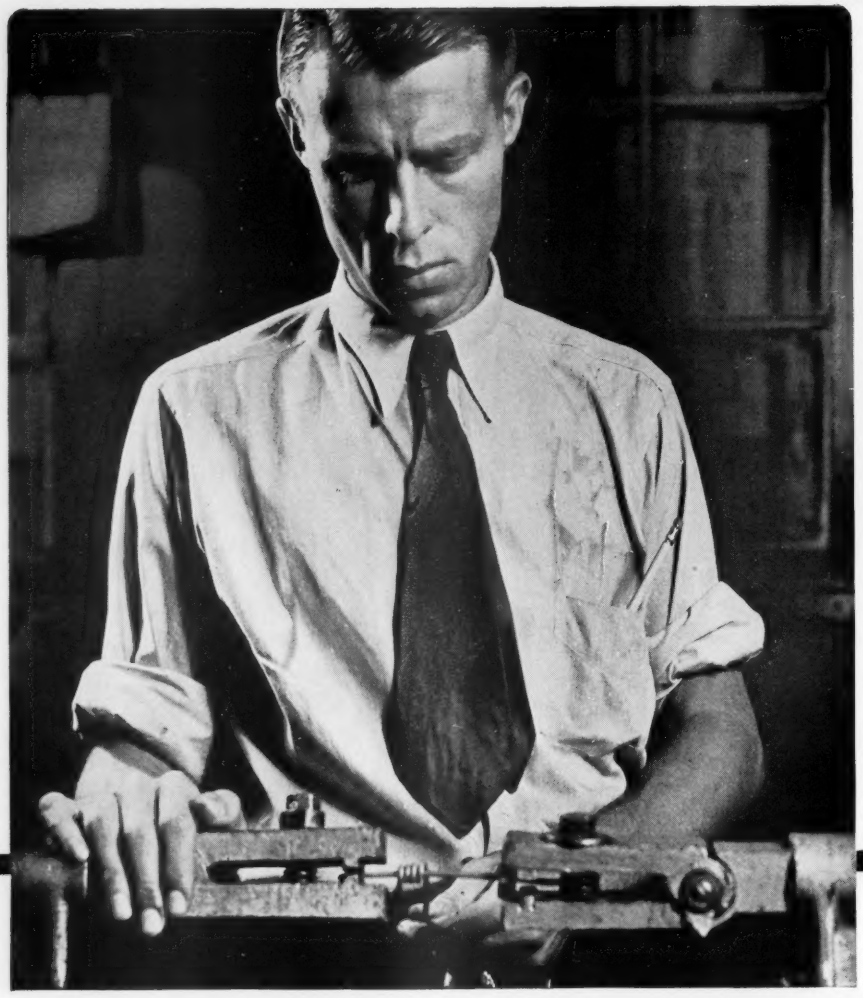


Extreme ductility and adhesion of Meaker process zinc coating illustrated above. Photograph of No. 12 wire shows steel completely severed by bending. Pieces held together by portion of zinc coating which acts as hinge when pieces are bent back and forth. (Zinc 2.4 oz. per sq. ft.)

THE MEAKER CO.

1629-1641 South 55th Avenue (Cicero Station)

CHICAGO, ILLINOIS



HIS JOB: Looking for Trouble

He's an inspector in a Pitttburgh Steel Company mill, yet he's looking for trouble in *your* plant. He knows that a defect or a departure from specifications in the wire you have ordered will raise hob with your production. It's his job to see that the wire shipped to you is exactly what you ordered.

Every coil of it, every carload, must be exactly like every other coil and carload. Uniformity is his watchword. Our engineers help you find the right wire for your particular problem, our inspectors see that you get it. Please feel free to consult us about your wire problems at any time.

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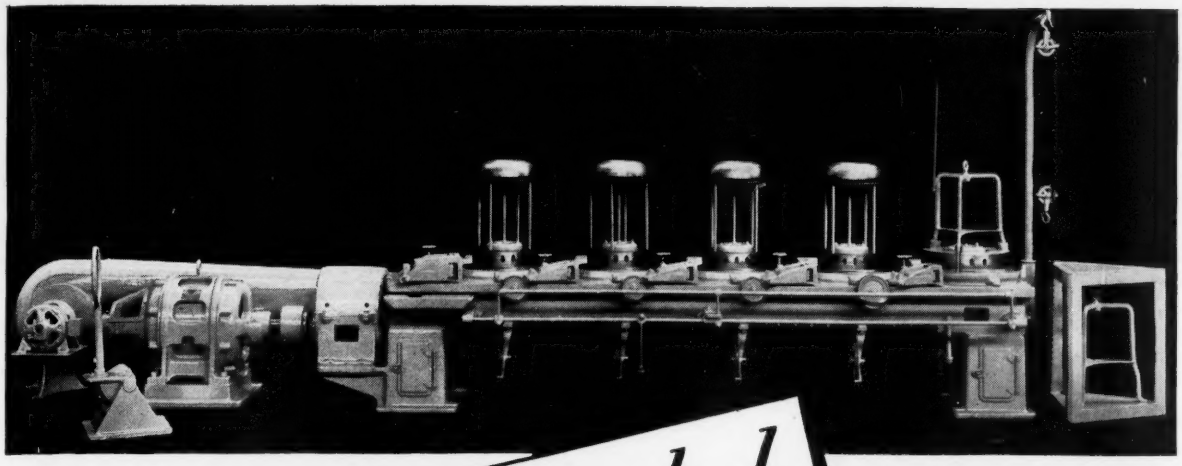
NEW YORK PHILADELPHIA SYRACUSE DETROIT CHICAGO ST. LOUIS
CHARLOTTE, N. C. MEMPHIS HOUSTON SAN FRANCISCO LOS ANGELES

Pittsburgh Wires
FOR EVERY PURPOSE

Spring Wire • Chain Wire • Box Binding Wire • Lavite Annealed Wire • Cold Heading Wire • Core Wire • Welding Wire • Spoke Wire • Bail Wire
Bolt Wire • Rivet Wire • Cap Screw Wire • Chaplet Wire • Nail Wire • Crimping Wire • Link Wire • Stapling Wire • Tack Wire • Spark Plug Wire



Morgan-Connor Continuous Wire Machine, Type B. Fully equipped with motor and control, air-cooling system, clutches and safety stops. Designed to start from commercial No. 5 rod in either high carbon or softer grades.

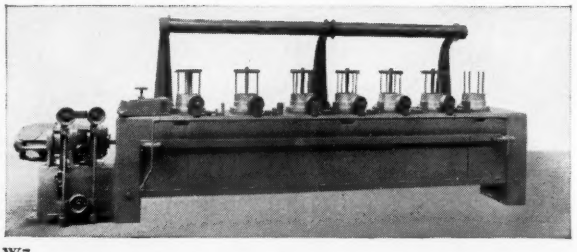
Air cooled PROFITS

● Modern wire drawing practice recognizes the distinct advantages offered by air-cooling between dies. Long regarded as essential in the drawing of high-carbon stock, it is now generally accepted as improved practice for low carbon wire as well.

The patented air-cooling principle is but one of the many advantages offered by Morgan-Connor Continuous Wire Drawing Machines. The distinctive high block design provides for ample wire storage between drafts, permitting a number of wraps sufficient to eliminate slippage. An improved clutch arrangement permits butt welding without interruption. Withdrawal of wire from each block is effected by uncoiling rather than unwinding. Die wear is reduced. Constant higher speeds with greater uniformity are possible.

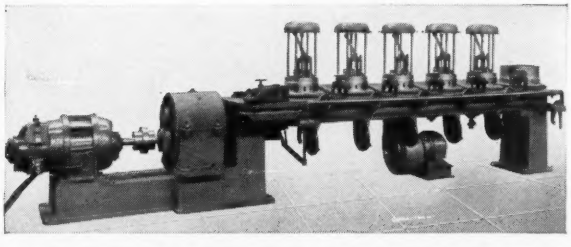
Compact design saves floor space; modern safety devices protect labor. Morgan-Connor Continuous Wire Drawing Machines have proved themselves to be production units that help make labor and floor space pay dividends.

MORGAN CONSTRUCTION COMPANY, Worcester, Mass., U. S. A.



W7

Morgan-Connor Continuous Wire Machine, Type D. This machine is designed especially for the drawing of finer sized wire. Starts from No. 17 patented wire.



Morgan-Connor Continuous Wire Machine, Type C. Fully equipped with motor and control, clutches and safety stop. Machine takes wire either hard drawn or annealed. Patented wire can be started at about 11 gauge.

MORGAN *Wire* Machines

MORGAN WORCESTER ENGINEERS AND MANUFACTURERS

An Invitation is Extended to YOU to Become a Member of

The Wire Association

ANNUAL DUES $10.00 PER YEAR

A MEMBERSHIP ENTITLES YOU TO THE FOLLOWING:

The assistance of other members of the Association in solving production questions.

Meetings with men engaged in problems similar to your own and the exchange of ideas.

Participation in technical sessions and discussions and admission to the annual meetings.

The services of the Association information and research facilities.

A subscription to WIRE & WIRE PRODUCTS—the official publication of the organization.

A copy of the Annual Buyers Guide and Year Book of the Wire Association.

Fill out the membership application blank below and send it in immediately.

THE WIRE ASSOCIATION

17 East 42nd Street, New York, N. Y.

The undersigned hereby applies for membership in the Wire Association, and agrees to be governed by the Charter and By-Laws of the Society and to further its objects as laid down therein.

Name .....

Address .....

Nature of Business .....

Name of organization with which applicant is affiliated and official title or occupation:

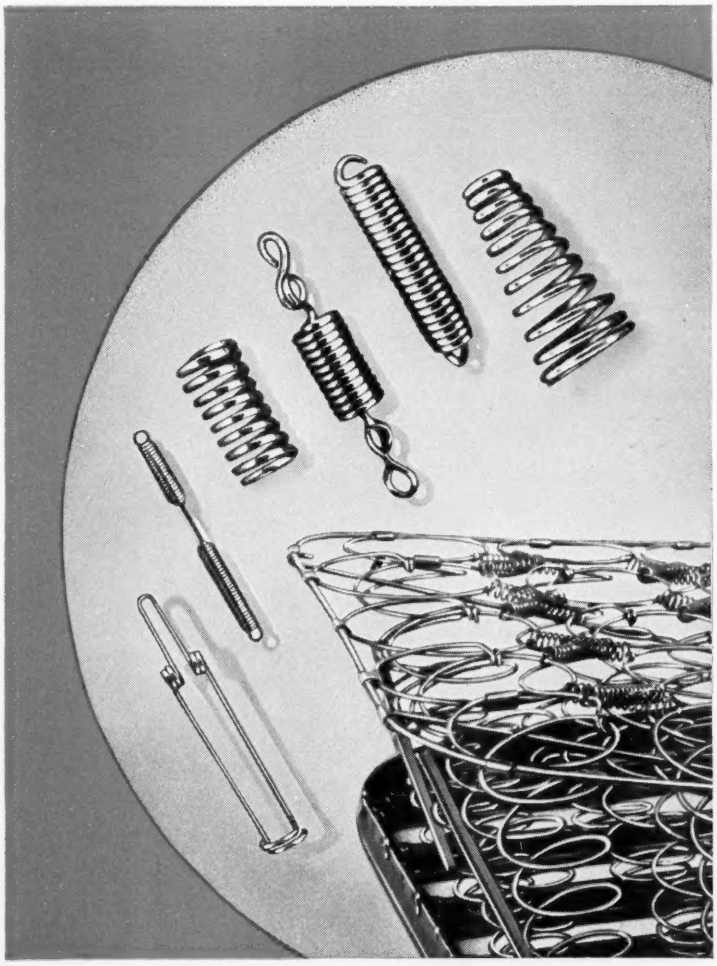
Name .....

Address .....

Applicant's Title or Occupation .....

For Speedy Production of Quality Springs

Standardize on J&L Spring Wire



Increased production, and definite assurance of uniform high quality springs—these are advantages you get when you standardize on J & L Spring Wire.

J & L Spring Wire helps you increase production, because it lends itself so readily to coiling, crimping, knotting and other forming incident to spring making. It assures uniform high quality springs because it has the resilience to provide just the right springiness, and the stamina to hold that springiness indefinitely.

The high quality of J & L Spring Wire results from the use of special steel, exact heat treating, accurate drawing and critical inspections and tests to insure uniformity to specifications.

The wide variety of springs made of J & L Spring Wire, a few of which are illustrated here, emphasizes the satisfaction with which it is being used throughout industry.

Many manufacturers have standardized on J & L Spring Wire because of its uniform high quality, and because it has the correct balance of physical properties to permit uniform, speedy production of springs of superior quality.

You, too, will find that it will pay you to look to J & L Spring Wire for *your* requirements.

J&L STEEL

OTHER J&L PRODUCTS

For Manufacturing: Cold Heading Wire—Forging Steel—Jalcase Steel—Improved Bessemer Screw Steel—Shafting—Tubing—Tin Plate, Black Sheets, and Light Manufacturing Ternes, Tin Mill Sizes—a full line of S.A.E. Carbon Steel.

For Construction & Maintenance: Structural Shapes, including Junior Beams and Lightweight Channels—Concrete Reinforcing Bars—Steel Pipe—Structural Shapes and Plates—Steel Piling—Fabricated Structural Work—Nails.

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AMERICAN IRON AND STEEL WORKS
JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

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* Operated by National Bridge Works Division of Jones & Laughlin Steel Service, Inc.
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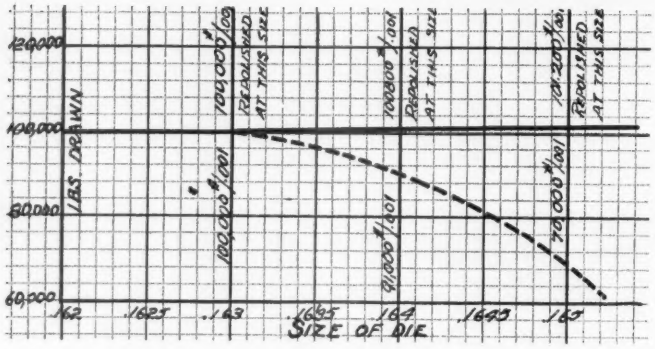
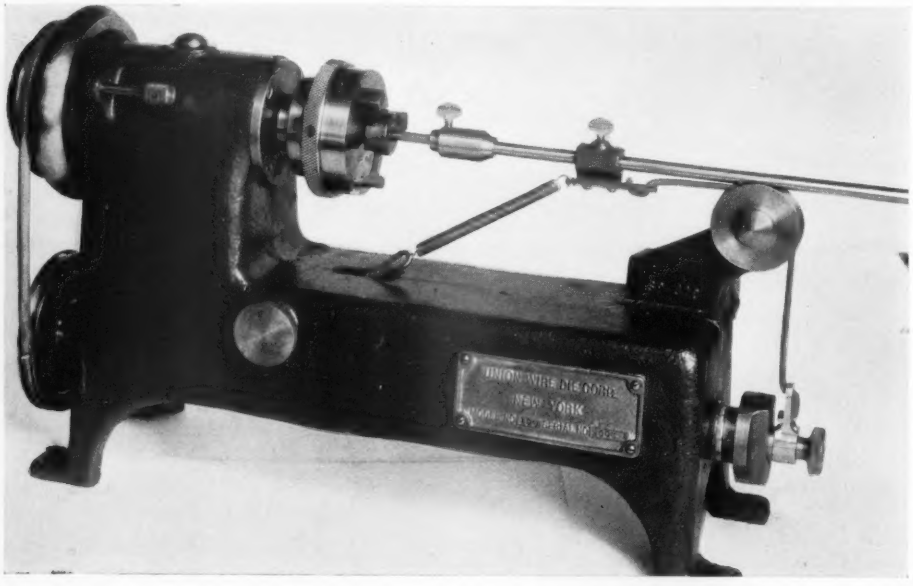
Another Reason for **UNWIDIE** *Supremacy*

SOLID LINE shows production per mill of wear if periodically repolished.



BROKEN LINE shows production per mill of wear if die received no attention.

THE GRAPH illustrates that a die, repolished at each mill of wear to renew the drawing surface, produced twice the amount of wire, as did the die which was neglected. The tendency being increased production per mill of wear on the repolished dies, and decreased production per mill of wear on the non-polished dies. While the relationship of poundage to wear will not always be constant, it has been found that mills have cut down on their replacement costs as much as 40% by this simple rule of repolishing. OUR MODEL No. 150 POLISHER, shown below, costs only $90.00 and should in a year, pay for itself several times over. It will aid you greatly in producing better wire at reduced costs, due to your savings in replacements of dies.



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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. II September 1936 No. 9

Designated as
Official Publication By The Wire Association

Contents

Wire Bakers, Past and Present ..... by Kenneth B. Lewis 423

A study of the development of the wire baker and an analysis of the present day method of indirect-fired convection baking, and a forecast as to future developments in design of such bakers as may occur.

Factors Affecting the Performance of Springs ..... by J. W. Rockefeller, Jr. 426

This is a second of a series of articles on the general subject of "The Design of Mechanical Springs". This article covers fatigue, corrosion, corrosion-fatigue, surface defects, and stress concentration.

The Preparation and Microscopic Examination of Metallic Specimens, Part II ..... by G. W. Pirk 430

A study of the microscopic examination of metals published in three parts. Part II—Etching, both steel and copper.

Manufacture of Manila Rope Insulating Paper ..... by James F. Adams 436

An interesting manufacturing process showing the conversion of discarded Manila ship cable into a product highly useful to the wire and electrical industries.

Outstanding Personalities of the Wire Industry 439

Exports and Imports of Wire 440

A Review of Recent Wire Patents 442

'Round the World With the Wire Industry 443

Index to Advertisers 462

Buyers Guide 463-464

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Publication Office: Washington, N. J.

Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy Issued Monthly Foreign, $7.50

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For Better Dies For Every Job

Say VASCOLOY ▲RAMET

The Tantalum Carbide Die Material • • •

Harder than the hardest of steels, immune to the action of most industrial acids, Vascoloy-Ramet is daily winning a wider acceptance throughout the wire world.

There is a Vascoloy-Ramet Die for every job, and especially for yours.

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North Chicago, Illinois

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FIRTH-STERLING
FIRTHALOY
QUALITY

TUBE DRAWING MANDRELS

The closer tolerances, more rigid specification and increased use of alloy steels have brought tube makers new problems. Steel dies and mandrels fail to meet the new conditions. Many large manufacturers who are using both dies and mandrels made of Firthaloy are having no difficulty in meeting these new specifications and at the same time obtain superior finish both inside and outside.

The hard polished surface of Firthaloy mandrels will not pickup or hold the slivers that result in the scratching or marring of the finished work. They hold size over a long period of time giving remarkable "on size" footage, as well as eliminating frequent replacements.

The steadily increasing use of Firthaloy mandrels proves that they are very economical when their ultimate cost is compared with that of other mandrels, and when the long life and better finished tubing obtained is considered.

Firthaloy tube mandrels are available with shanks to fit your holder bars or rods and are furnished in all of the standard and special sizes.

FIRTH-STERLING STEEL COMPANY

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PHILADELPHIA
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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. II | SEPTEMBER 1936 | No. 9

Wire Bakers, Past and Present

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A study of the development of the wire baker and an analysis of the present day method of indirect-fired convection baking, and a forecast as to future developments in design of such bakers. ✦ ✦ ✦ ✦ ✦

WHEN Daniel Webster remarked that he knew of no better way to judge the future than by the past he might well have been speaking of the wire industry, of whose practises it may safely be said that a sound evaluation of their present and a fairly sure prediction of their future course requires some knowledge of their history. This knowledge is fairly easy to acquire in the case of baking, a process probably not more than seventy or eighty years old.

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THERE appear to be no references to drying or baking earlier than about 1860. Mr. Nehemiah Highley of Pittsburgh, whose recollections of the Tintern Abbey mills in Wales go back to the 1850's, says that baking, or "blueing" as it was called there, followed the introduction of Bessemer steel. Wrought iron apparently absorbed little or no hydrogen. From time to time, says Mr. Highley, the cleaner would dump a load of pickled and sulled rods onto the floor with a shout, "Share it up, boys." In the rush which followed, each wire drawer would get three or four "fagots" of 14 lbs. each, which he would dip in his own lime tub and hang on pegs to be dried by the wind and sun.

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I HAVE a picture dated 1860 showing limed rods drying in front of an open fire. Mr. Highley accounts for this by saying that in winter a fire was kept burning in the wire mill to soften up the greases and other supplies, and that on bad days the rods were sometimes dried around this hearth.

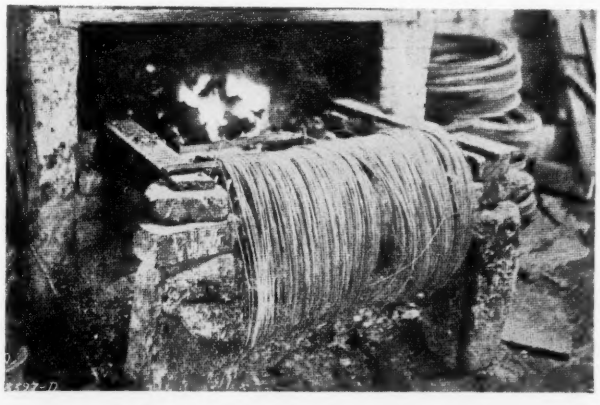

Fig. 1. Lime coated rods drying. 1860. ✦ ✦ ✦ ✦

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WITH the advent of Bessemer and later of open hearth rods, acid brittleness appeared and bakers were installed. Some of these early bakers may still be seen. They were thick-walled brick chambers with stoves in the corners, usually coke-fired and provided with smoke pipes to dispose of the fumes. I have within twenty years seen British wire drawers walking in and out of these primitive bakers with coils of rod on their shoulders.

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AN early step in evolution placed the fire box below ground, brick flues under the mill floor level, and cast iron plates to facilitate the use of trucks. As the Btu gained recognition the floor

plates were succeeded by gratings and the flues were given cast iron top plates so they would deliver more heat to the rods and less to the stack. Gradually the truth forced its way through our thick skulls that baker flues were different from ordinary flues in that their chief function was to lose heat rather than to conduct it, and we began to use all-metal flues. These soon began to burn out, and we began to learn what the products of the combustion of coal could do to limed rods in the sluggish atmosphere of the baker.

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FIG. 2 shows what was a baker of decidedly advanced design about twenty years ago. The flues had frankly become radiators, ribbed to deliver heat rapidly, and a slight pitch in the tracks testified to the fact that bakers were getting too hot for comfort. The most striking feature, however, was that a path was defined for the flow of air. Fresh air was deliberately admitted near the flues and spent air was vented through openings at the wet end of each alley. Separate alleys were already known; this design went further and gave each alley its own firebox, flue system, and air-circulating system.

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HAVING been concerned in the design and marketing of this baker I am in a position to report on the state of mind of the industry at the time. There was general recognition that high temperatures permitted shorter baking periods, but a wide-spread fear of "burning" the lime. The evil effects of flue leakage were well recognized. There was no argument about the desirability of getting rid of steamy air very promptly, and the little plume of water vapor at each vent stack was hailed with satisfaction. Ventilation had previously been quite accidental, under the doors, and through cracks in the walls and roof. Wire men were beginning to feel that good drying and baking were real factors in economical wire production. We were all eager but ignorant.

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IT must have been ten or fifteen years ago that somebody first put an electric fan into a baker and secured a turbulence of air. I suspect it was done to keep a hot flue from burning out, but it was quickly apparent that drying was greatly accelerated. At about this time a very wholesome change took place in the industry. Bakers had always been built either by home talent or by builders of wire machines who felt obliged to offer a complete line. Now the field began to be invaded by combustion engineers who were ready to apply lessons learned in other branches of industry. Their ignorance of wire mill practise handicapped them severely, but their ideas began to take root. Walls and roofs of insulated panels were suggested; bakers were built entirely above floor, with interior flues cooled by blown air, and the idea of recirculation began to make headway against wire mill prejudice.

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SOME of us had long ago envisioned the perfect baker as an insulated steel tube through which suspended rod bundles moved in one direction and a blast of hot air in the other, but we realized that the cost of the hot air would be prohibitive. The thought of recirculating the air was never entertained. We had had too much experience with the old air-tight bakers in which steam rose, circulated, settled back, and rusted the rods and wire. We failed to realize the advances made in the use of gaseous fuels and thermostatic control, and the fact that steam could not condense on rods that never dropped below 212°. We also overlooked the fact that air containing steam would give up its heat to incoming rods much faster than dry air.

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IT is only within the last four or five years that the heating engineers have been allowed to put over their complete program in the field of wire baking. The modern indirect fired convection baker is built up of steel panels about 4" thick, with rock-wool blanket insulation, whose outer surface is barely warm to the touch. The heating chamber, usually on the roof, contains thin-walled tubes through which the gases of combustion pass to the outer air and around which flows the fresh air on its way to the baking chamber, driven by a blower. The atmosphere in each alley is recirculated by this blower, through a definite path which takes it through the rods at a velocity expressed in terms of the number of complete air changes a minute, usually 2 to 4. A thermostat in each alley controls its temperature by opening a valve and bleeding into the air stream just so much of the freshly heated air as is required. As this fresh air is admitted a corresponding amount of old air is automatically vented, and since the

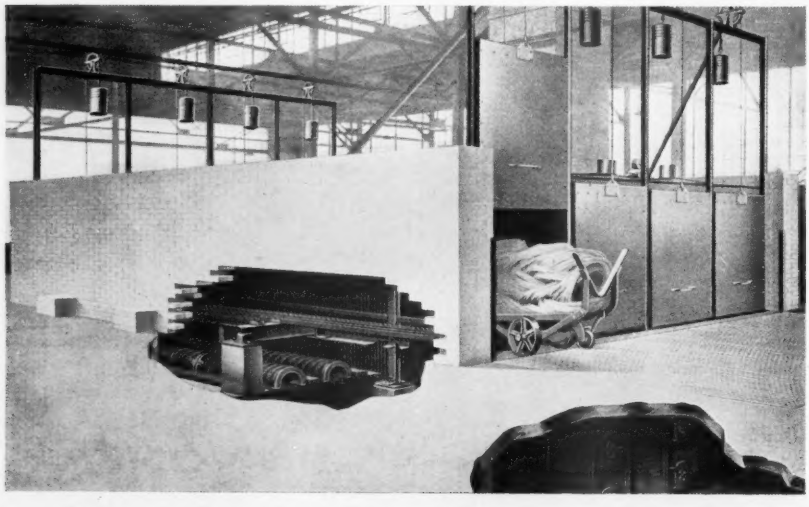

Fig. 2. Baker, 1916. Air inlets near floor, outlets over doors. ✦ ✦ ✦ ✦

call for fresh air naturally occurs when a wet load is introduced, this tends to keep down the amount of steam in the air, thus satisfying the prejudices of the wire men.

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HAVING been concerned in the installation and operation of several of these new bakers I have shed some of my preconceived notions about wire baking. I have used one baker in which the dampers were arranged for hand control and the atmosphere was recirculated right through the heating chamber and the results have forced me to the conclusion that the venting of steamy air is of very little consequence. This is rather hard for an old-timer to swallow, but satisfactory baking of rope, music, and valve spring wire in 1½ to 3 hours with closed dampers is apt to break down the resistance of the stoutest skeptic.

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OUR ideas regarding the importance of sweeping out steam were formed in the period when bakers were full of stagnant air and were generally cooled down past the dew point before or during stripping. We must revise these ideas. Another prejudice carried over from early days has now been challenged, and we must prepare to cast it overboard. This is the fear of the evil effects of products of combustion on the lime and on the wire. Recirculating bakers are now on the market for which the products of combustion, diluted with fresh air, are discharged direct into the baker atmosphere. We know very well that these gases contain the dioxides of carbon and sulphur, and that in the old fashioned baker they combined with water in the lime to form carbonic and sulphurous acids which altered the lime and pitted and rusted the wire. Whether due to some particular method of burning the fuel (understood to be covered by patents) or to the fact that moisture is snatched out of the lime so quickly that the anhydrides are unable to form acids, the fact remains that these evils are not resulting. Having freely predicted disaster for these direct fired bakers I feel I owe it to their sponsors to admit that on personally checking most of those in service I find them doing a completely satisfactory job in a range of work including coarse rods for bright drawing, 16 gauge process wire, and high grade spring and alloy steels.

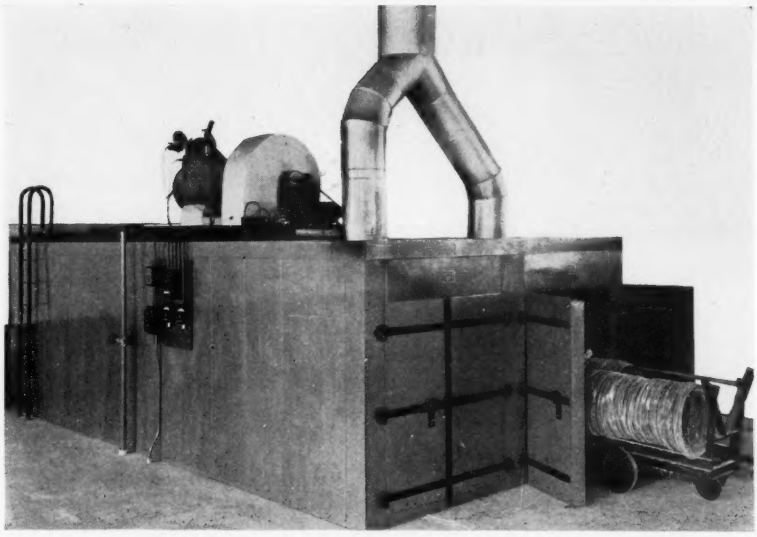

Fig. 3. Modern Convection Baker, Direct Fired.

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VERY few wire mill improvements have been so promptly and generally accepted as these recirculating bakers. Unlike most new things, their first cost is decidedly lower per unit of capacity than that of the old baker and the floor space is greatly reduced. The indirect fired type usually shows a fuel saving over the old baker, and the direct fired shows further saving over the indirect, of the order of 50%. Both direct and indirect fired are doing a cheaper, faster, and cleaner job.

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THE recirculating baker has scarcely got established, and it is hard to forecast changes in baking. Probably we face a revision of our ideas as to what degree of baking is essential. Bakers have long been regarded as floating storage between cleaning house and mill, and length of drying and baking has depended more or less on pressure from the wire mill. The use of carbide dies has made it less hazardous to store coated rods on the mill floor; hand to mouth buying has become the normal, and it is probable that the baker will in the future keep more in step with the cleaning line and less with the wire room. Higher temperatures will probably become the rule, and with them must come more satisfactory systems of moving rods through the baking chamber. This matter cannot be standardized. Some situations lend themselves readily to gravity tracks, some to pushers, some to tramrail, and each case must be thought out carefully on the spot. At any rate the combustion engineers have given us a precision tool and I am sure we can be trusted to make the best possible use of it.

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Factors Affecting The Performance of Springs

By J. W. Rockefeller, Jr.,
Consulting Engineer, New York, N. Y.

This is a second of a series of articles on the general subject of "The Design of Mechanical Springs". This article covers fatigue, corrosion, corrosion-fatigue, surface defects and stress concentration. ✦ ✦

IN the previous article of this series, it was pointed out that in many cases the ordinary formulae for spring design could not be relied upon in their unmodified form due to their failure to take into account such factors as locked up stress in the finished spring, curvature of the bar or wire in both compression and torsion springs and a number of other factors which might be safely ignored in the average case but which became important in certain cases of design. In addition to such factors, there are performance factors produced by service conditions under which springs operate which must be given careful consideration by both the designer and manufacturer of springs, Some of these factors which are most commonly encountered in practice are fatigue, corrosion, corrosion - fatigue, resonance, and stress concentration brought about by surface defects. (The last named factor may be a condition brought about either in the manufacturing stages or produced by operating conditions; as will be explained.)

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WHILE the subject of metals fatigue under cyclic stressing is not new, it is one that has become the subject of wide investigation since the introduction of rapid means of transportation and high speed motors. Corrosion-fatigue, on the other hand, until very recently had received little attention on the part of investigators, but the results which have been obtained in this field have been such as to emphasize its importance to the user and manufacturer of springs and have indicated that corrosion, even so slight as to be invisible to the naked eye is frequently the cause of spring failure when accompanied by cyclic stressing.

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IT is impossible, in an article of this length, to more than touch upon the general subjects of fatigue and corrosion-fatigue and the reader is recommended to the excellent work of McAdam, Moore and Kommers, Gough, Lea, Haigh and other investigators in this field. From their investigations, it appears that the fatigue limit of a material under complete reversal of stress bears a closer relationship to its ultimate strength than to any other property. For materials used in bending the safe stress under reversed bending is in the neighborhood of 50% of this figure while in reversed torquing the limit is approximately 25% of this figure for most spring materials. Raising the proportional limit of a material through heat treatment appears to have but little effect upon the fatigue limit of a metal.

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AS the result of attempts to relate fatigue range to average stress of the cycle, the modified Goodman diagram (Fig. 1.) was developed, upon the assumption that as the mean stress of the cycle increased, the range decreased, as shown, until it became zero at the ultimate strength of the material. While experimental results of fatigue tests agreed very well with the fatigue range as indicated by the modified Goodman diagram in the case of some metals, tests upon the materials most commonly employed for springs showed but little decrease in fatigue range for an increase in average stress of the cycle within the elastic limits of such materials. Fig. 2, a further modified form of Fig. 1, seems to agree more closely with actual results

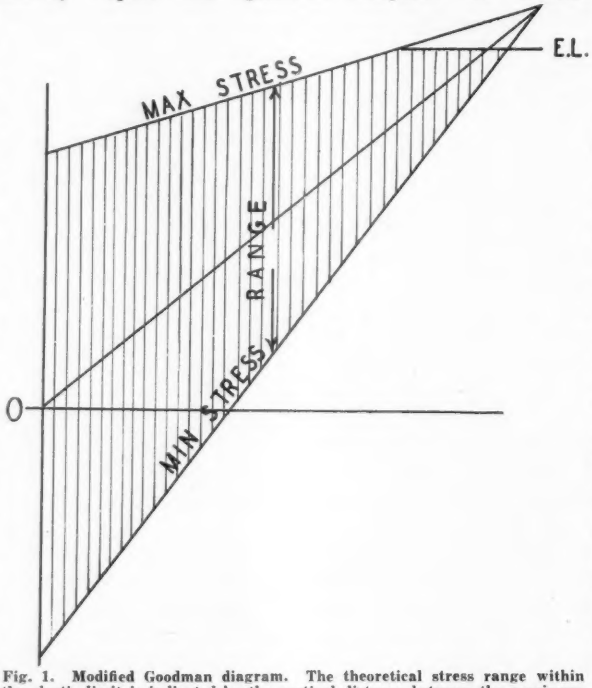

Fig. 1. Modified Goodman diagram. The theoretical stress range within the elastic limit is indicated by the vertical distance between the maximum and minimum stress during the cycle. The maximum range is obtained when the average stress during the cycle is zero. The stress range for any mean stress may be obtained by the following formula:

$$R = Rr \left(1 - \frac{M}{f} \right)$$

R = Safe range at M mean stress
Rr = Safe range at M = O
M = Mean stress of cycle
f = Ultimate strength.

While the Modified Goodman diagram is applicable in the case of some metals it does not yield results that check closely with actual tests on spring materials generally. ✦ ✦ ✦ ✦ ✦ ✦

in the case of spring materials.

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IT will be seen that while the elastic limit of a material is not indicative of the material's fatigue limit, it is an important criterion of the fatigue range that may be expected at given stresses and therefore becomes a factor to consider in the design of springs which are subjected to service where fatigue conditions apply.

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Corrosion

SINCE springs are usually designed to operate at high stresses corrosion frequently becomes more of a problem in their case than in many other members used in machinery. Any corrosion resisting treatment which tends to alter the micro-structure of the material and thus affect the physical properties of the spring itself must be given more careful consideration than in the case of metal parts that are not as highly stressed or whose chemical composition renders them less affected by thermal treatment. The fact that springs must undergo a comparatively large deformation in service further adds to the complications of rust protection. As in the case of other members, spring corrosion depends primarily upon three factors viz., the nature of the spring material itself, the nature of the surrounding medium and the nature of the metal parts with which the spring is in contact. During the manufacturing operations, all three factors may be carefully controlled but after the spring leaves the shop the manufacturer has no way of knowing just what conditions are likely to be encountered and it happens occasionally that a spring that has been standing up satisfactorily in service will suddenly give cause for complaint due to a change in conditions under which it is used or a change in some part of the assembly of which the spring forms a part. In the case of instrument springs such as those used in spring balances, a slight rusting will oftentimes cause inaccuracies in the instrument's calibration which may not be noticeable but which may result in a serious loss through long weight over a period of time. Perhaps the chief interest of the spring maker in the subject of corrosion, however, is its effect upon the fatigue properties of a spring when corrosion and cyclic stressing take place simultaneously. This condition is particularly detrimental in the case of valve springs and other springs undergoing millions of repeated stressings during their normal life.

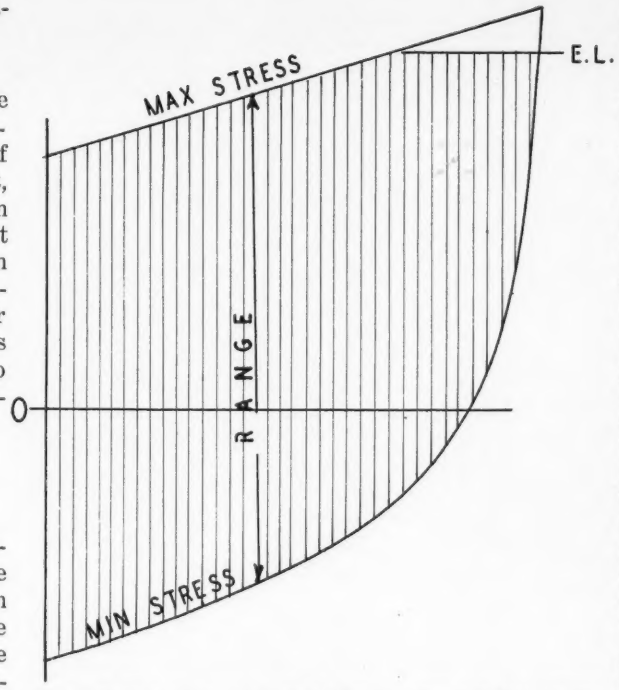

Fig. 2. Diagram based upon actual tests of spring materials, showing variation of stress range with increase of upper stress limit of cycle. The reduction in stress range as average stress of cycle is increased is considerably less than that indicated by the Modified Goodmand Diagram. ✦

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Corrosion-Fatigue

CORROSION-fatigue tests upon prepared specimens in the laboratory have shown that where cyclic stress is accompanied by mild corrosion, the fatigue limit of a material may be reduced as much as from 50% to 80% of its fatigue limit in dry air. The fact that specimens tested in a vacuum

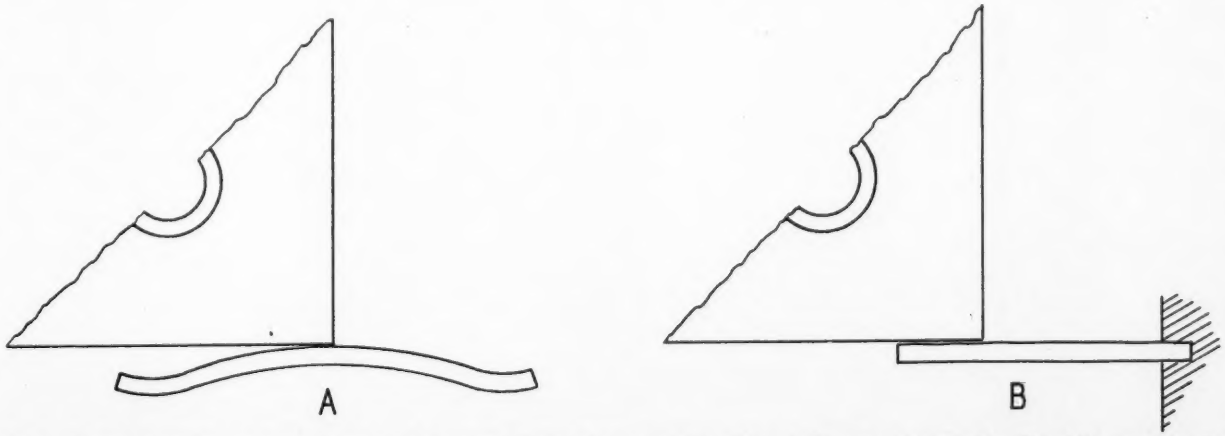

Fig. 3. Diagram indicating how spring failure was overcome in the case of an automotive spring. A shows the original spring. The nicking caused by the rotating square member occurred at a point of maximum stress and greatly reduced the fatigue strength of the spring. In the redesigned spring the nicking occurred at a point of minimum stress resulting in elimination of spring failure. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

have shown an improvement in fatigue properties over those tested in the dry air of laboratory indicates that the dividing line between pure fatigue and corrosion-fatigue must indeed be finely drawn.

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Laboratory vs. Service Tests

WHILE laboratory fatigue tests upon spring materials are useful to the spring manufacturer, they require careful interpretation in the light of experience gained in actual practice if they are to have the maximum value. Laboratory fatigue tests are made upon carefully prepared specimens, under ideal conditions and may be misleading if they are accepted as being truly indicative of what may be expected of commercial springs under service conditions. It has been found by Batson and Bradley that the safe range of stress in the master leaf of a laminated spring was only from 22% to 40% of the estimated safe range based upon fatigue tests of test specimens of the material itself and more recently by J. B. Johnson that in the case of compression springs the fatigue limit was but 50% to 80% of that calculated from the fatigue tests of torsion specimens. It was found further that the material which gave the best results in the case of prepared specimens was not that possessing the highest fatigue properties in the case of the finished spring.

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WHILE pure fatigue conditions may apply in the case of tests conducted in the laboratory, it is in all likelihood, very seldom indeed that fatigue unaccompanied by even slight corrosion is the cause of spring failure in actual service. Laboratory tests on the fatigue properties of spring materials are usually accelerated for the sake of obtaining the greatest amount of information in the shortest possible time. The amount of corrosion taking place per thousand cycles of repeated stress may therefore be small compared with that which takes place in the field. Corrosion, through the agency of strong chemical action is not necessary for corrosion fatigue failure. In pre-corrosion tests the exposure of one week to tap water was found to be more injurious to the specimen than immersion for one hour in a 10% solution of sulphuric acid.

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IN actual service the history of a spring's failure through corrosion-fatigue causes is seldom identical with that of specimens tested in the laboratory. In the former case the condition of the atmosphere or surrounding medium is ordinarily fluctuating, the content of gases which are conducive to corrosion as well as humidity changes and other changes depending upon the weather may be expected to be varying, nor is it necessary that conditions conducive to corrosion-fatigue obtain throughout the serviceable lifetime of the spring. Corrosion-fatigue may occur over a limited period during which damage is done to spring's surface resulting in a condition of pitting, cracking etc. Once this damage is done, conditions may alter to the extent that little if any further corrosion takes place, but failure as the result of cyclic stress will result due to the spreading of surface defects brought about by earlier conditions.

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DURING this second stage failure will proceed according to the general laws of fatigue failure and it is difficult, in many cases, to tell from a casual inspection of the fracture whether it was brought about by fatigue or corrosion-fatigue.

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LET us consider the case of springs used in automotive assemblies. Some of these will be exposed to the salt laden atmosphere of the sea shore, others to the industrial atmospheres of such cities as Pittsburgh and many will be affected by chemicals used upon highways to lay dust or to melt ice. The manufacturer of such springs is bound to consider the effect of corrosion-fatigue as well as pure fatigue when such springs are to complete a large number of repeated stressings.

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AS the importance of this cause of spring failures becomes more apparent, it is to be expected that more thought will be given to its prevention and we may expect the increasing use of corrosion resisting alloys and plated springs. Cadmium plated steel springs may be expected to have a corrosion limit about 100% higher than similar springs which have not been so coated.

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IN actual service, springs are more often subjected to repeated stressing on one side of the neutral position than to reversed stressing, and since most of the research work conducted upon spring materials has been upon the latter basis, it will be necessary for the designer of springs to bear service conditions in mind when interpreting the results of investigators in this field. Thus a spring material having a fatigue limit of 40,000 lbs. per sq. in. may ordinar-

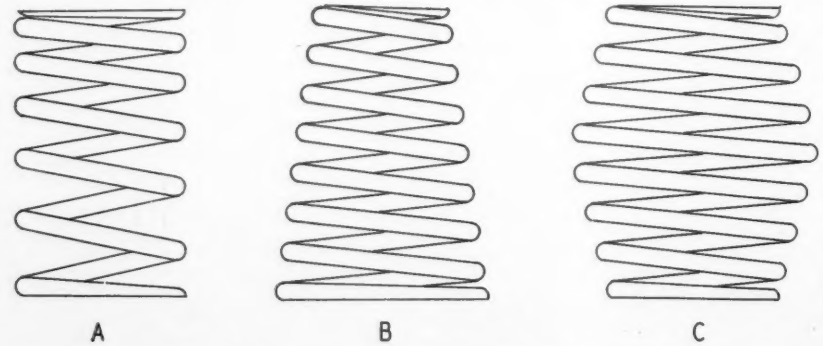

Fig. 4. Valve springs designed to suppress harmonics. A. Helical spring of varying pitch. B. Conical spring. C. Barrel spring.

ily be stressed from 0 to 70,000 lbs. per sq. in. under conditions of pure fatigue, or from 20,000 lbs. per sq. in. to 85,000 lbs. per sq. in., provided the elastic limit of the material is not exceeded in so doing.

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BEFORE the subject of corrosion-fatigue had been investigated to the extent that it has today, it was assumed by designers that the weakening of materials through corrosion was accomplished solely through the reduction of area of the section. Recent research, however, has proved quite conclusively that considerable reduction in fatigue strength may result through corrosion even though the reduction in area of the section is so slight as to be negligible. In the case of springs, surface irregularities caused by means other than corrosive agencies are frequently the cause of spring failure, brought about by concentration of stresses in the areas of such irregularities. In the early days of alloy steels in spring manufacture, the manufacturer was frequently misled into accepting tests upon straight carbon and alloy steel springs as being indicative of the properties due solely to chemical composition of the material whereas in reality, the difference in surface finish of the materials under test was chiefly responsible for the differences shown in the tests.

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SURFACE decarburization, scratches, and seams are absolutely fatal to the life of springs operating under conditions of repeated stressing, even when such defects are microscopic in magnitude. The proper methods of inspection both of material and finished springs, in order to eliminate these causes of spring failure are necessary in the case of valve springs and other springs expected to stand up under a large number of loadings.

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BY immersing springs in a bath of white lead and wiping it from the surface of the spring while in the unstressed state, stressing will sometimes force it from seams and cracks, too minute to be observed by the naked eye. A method of testing which has come into use lately and which appears to possess certain advantages over any method heretofore tried, is the magnetic method, in which iron filings are either dusted on a previously magnetized spring or the spring so treated is immersed in an oil in which such filings are in suspension. When a seam or crack is present in the spring material the iron filings are strongly attracted to the material in such areas and thus indicate the presence of the defect.

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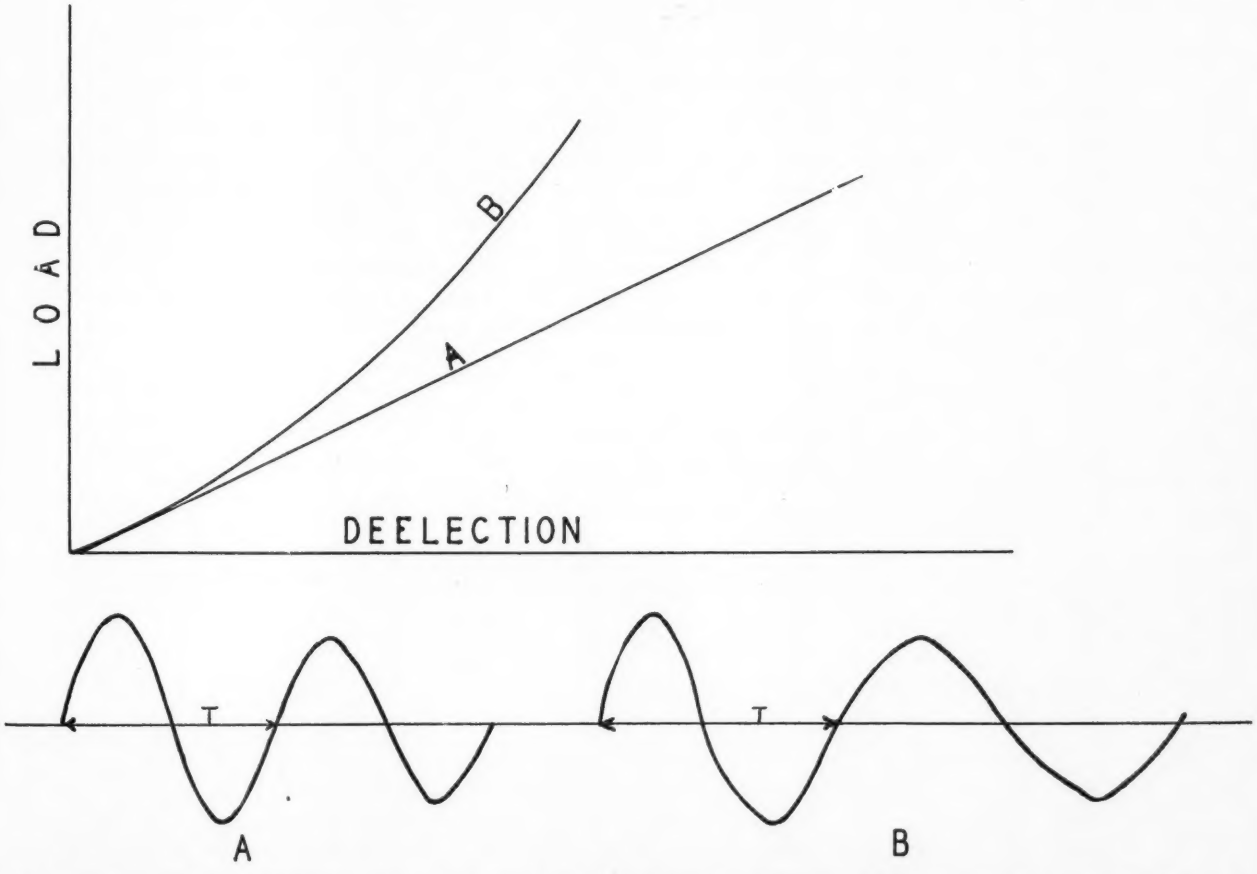

Fig. 5. Load deflection curves of straight helical spring (A) and spring designed so that some coils close before others (B). The vibration characteristic of each type is shown below. T indicates the time of a complete cycle. It will be noted that for the straight helical spring the period of vibration is the same regardless of the amplitude of vibration while for springs of type B the period increases as the amplitude decreases. ✦ ✦ ✦ ✦

The Preparation and Microscopic Examination of Metallic Specimens

PART II, ETCHING

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A study of the microscopic examination of metals published in three parts. Part I—Method of selecting sample, cutting the specimen, mounting the specimen, and polishing the specimen. Part II—Etching, both steel and copper. Part III—Results obtained from the microscopic and macroscopic examination of metals. ✦ ✦ ✦

Etching

DURING polishing there is formed on the surface a thin layer of flowed metal. (14) This must be removed in order to reveal the true structure of the metal or alloy. In order to remove this flowed metal the surface is treated with a chemical reagent. The process of chemical attack in order to reveal the surface of the metal is known as etching.

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ETCHING is primarily a differential chemical attack on the various constituents which are present in a metallic aggregate. The value of a good etching reagent lies in the fact that it will develop the structure as it actually exists. The action of the etching reagent must not be drastic or the contrast between the various constituents will be destroyed. The degree of activity can be controlled by using solutions of various concentrations. It is a very rare occurrence to employ a concentrated etching reagent where it is desirable to develop the fine structure of the metal and bring out fine detail.

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THE structure of a metal as it is seen under the microscope is dependent upon the chemical composition of the metal and its thermal and mechanical treatment. Generally, a pure metal presents a polygonal structure. Although the metal is quite pure the surface will not be uniformly attacked by the etching reagent. Because of the random orientation of the crystals of a metallic aggregate, various faces of the crystal are exposed to the etchant and are more readily attacked than others. The result is that there will be a difference in level between the crystals, the boundaries between the crystals showing up as dark lines. If the etching be continued for some time little valleys will develop at the grain boundaries. This is due to the fact that the metal at the grain boundaries dissolves more rapidly than that on the crystal faces. The etching reagent also roughens the surface of the crystal and in some cases forms a film or an oxide. Since the crystals are differentially attacked depending upon the particular crystal facet which is exposed, some will appear lighter than others. Those crystals which reflect the light up the microscope tube to the eye will appear bright, whereas those crystals which have their planes so placed that they reflect light outside the microscope tube will appear dark.

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IF an alloy is composed of two or more elements which form a compound or produce a structure different from that of the pure metal, it may be identified by the peculiar structure exhibited. Very frequently the constituents of an alloy will be stained a characteristic color. This then affords a means of recognizing the elements of alloys.

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BEFORE starting the etching the sample should be thoroughly cleaned and dried. The sample while being immersed in the etching reagent should be kept in motion or swabbed with cotton. This will keep a fresh portion of the reagent in contact with the sample and will remove any gas bubbles which may form as the result of the chemical attack and will make for a more uniform etch.

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THE degree of etching must be carefully controlled. This is generally done by varying the time of etching since for most routine inspections definite combinations of chemicals are used, whose manner of attack are fairly well known.

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DEEP etching or over etching is to be avoided. For examination at high magnification the degree of etching should be lighter than for low power work. An etch suitable for low power (75-200 diameters) will produce too much relief and makes sharp definition practically impossible at 500 diameters or above. It is therefore generally advisable to start with a light etch and do the high power examination and then etch somewhat deeper and do the low power work. In order to perform an examination at high power after a relatively deep etch for low power work it is necessary to go back to the paper and repolish. If the high power work is done first, repolishing is not necessary.

It is better to repeat the etching process several times than to over etch. In the case of stainless steel it may be necessary to polish, etch, repolish and re-etch several times in order to remove the distorted metal produced by grinding and polishing and expose the true structure. Aluminum and its alloys may also have to be repolished and re-etched once or twice to get fine definition.

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IN some cases, especially when two constitutents are present, greater contrast will be obtained if a combination etch is used. For instance, when alpha and beta structures are present as in 60-40 brass, a ferric chloride etch following the regular ammonia-hydrogen peroxide etch will add contrast by darkening the beta constituent. In the case of phosphor bronze and copper beautiful coloration and contrast can be obtained by following the ammonia-peroxide etch by a few seconds of electrolytic etching. When studying the copper-beryllium alloys much better results are generally obtained if a light etch in potassium bichromate precedes the electrolytic etch.

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ELECTROLYTIC etching is particularly suited to the etching of tungsten, copper-nickel, copper-tin alloys and Monel metal.

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ELECTROLYTIC etching has much to commend it since considerable variation is possible by varying both the time of etching and the current density.

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MOST etching procedures can be carried out by means of a relatively few reagents. In the following tables and paragraphs will be given a rather complete list of etching reagents for iron and steel and for copper and its alloys.

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Iron and Steel

MILD or light etching reagents are generally used for iron and steel. For ordinary carbon steels, wrought iron, cast iron, etc., solutions of nitric or picric acid in ethyl alcohol will generally suffice. When it is necessary to detect the various carbides alkaline reagents such as sodium picrate or potassium ferricyanide are used. Stainless steels are treated somewhat differently and may be successfully etched with either aqua-regia diluted with glycerin or by using the electrolytic etch.

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ELLINGER (Trans. A.S.M. Vol. XXIV, No. 1, March 1936, page 28) has developed an etching reagent for the electrolytic etching of stainless steel. The reagent is claimed to reveal both carbides and grain boundaries in the 18% Cr—8% Ni corrosion resistant alloys. It is rapid in its action, is suitable for high power work, and is less dangerous to use than sodium cyanide. The reagent consists of:

10 grams Oxalic Acid
100 c. c. distilled water

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THE polished specimen is made the anode and a piece of platinum gauze, the cathode, the two being about one inch apart. Current from a 6 volt storage battery or from 4 dry cells connected in series is passed through the solution. The time of etching is given as 15-30 seconds to reveal carbides and 30-60 seconds to show grain boundaries. A variable resistance placed in the circuit will make it possible to get better control of the etching procedure.

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TABLE 1 of etching reagents as shown is very convenient in that it is a condensed and concise catalog of the composition and use of the various reagents used for iron and steel.

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IRON and steel generally contain foreign inclusions which can be readily identified by following the scheme developed by Campbell and Comstock and modified by Wohrman. This scheme is presented in table IV.

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A QUICK and easy method of revealing carbides and carbide grain boundaries in steel is by means electrolytic etching, with alkaline sodium picrate. The method can also be advantageously employed in studying the grain size of carburized surfaces. The etchant is prepared as follows:

Picric Acid—2 grams
Sodium Hydroxide—25 grams
Water—100 c. c.

The above quantities after preparing may be diluted 50% if necessary.

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A 6 volt storage battery or several dry cells are used as a source of direct current. The sample is connected as the anode and a platinum disk or stainless steel strip may be used as the cathode. The time of etching is about 40 seconds. When a storage battery is used as a source of current supply it is best to employ the full strength solution.

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Copper and Its Alloys

THE remarks that apply to the etching of steel are equally applicable to copper. There are a few points, however, that need amplification.

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THE reagent most generally employed for copper and its alloys is ammonia and hydrogen peroxide. The proportions of ammonia and hydrogen vary to some extent with the copper content. Generally pure copper takes a greater content of peroxide which acts as the oxidizng agent, than do copper alloys. For example to etch pure copper 5 parts each of distilled water and concentrated ammonium hydroxide (0.88 Sp. Gr.) and two parts of 9% hydrogen peroxide are used.

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IF instead a brass containing 65% copper and 35% zinc is to be etched the proportion of ammonia and distilled water remain the same, but only one part of 9% hydrogen peroxide is used. Pure beta brass may be etched with the last combination. However, duplex or alpha plus beta brasses are etched as for yellow brass (70-30) then in ferric chloride to darken the beta and increase its contrast. Where massive areas of the beta constituent are present in an alloy copper ammonium chloride solution will darken the beta and give good contrast following the regular peroxide etch.

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IN many instances a combination of etching reagents must be

TABLE 1 ETCHING REAGENTS FOR MICROSCOPIC EXAMINATION OF IRON AND STEEL

Etching Reagent	Composition		Remarks	Uses
No. 1. Nitric acid (2 per cent Nital)	HNO_3 (conc.) Ethyl alcohol (abs.)	2 ml. 98 ml.	Only clear white HNO_3 (sp. gr. 1.42) should be used; time, a few seconds to about a minute.	For carbon steel, iron, and cast iron. Nital brings out grain boundaries clearly; carbides are unetched for the structures of nitrided steels.
No. 1A. Nitric acid (1 per cent Nital)	HNO_3 (conc.) Ethyl alcohol	1 ml. 99 ml.	See reagent No. 1.	For tempered samples.
No. 2. Picric acid (5 per cent Picral)	Picric acid Ethyl alcohol (abs.)	5 g. 100 ml.	Clean, dry, picric acid crystals should be used; time, a few seconds to about a minute or more.	Same as reagent 1A; the grain size of quenched steels is brought out after prolonged etching; picral shows detail more delicately than nital.
No. 3. Sodium picrate	Picric acid Sodium hydroxide H_2O	2 g. 25 g. 100 ml.	Use boiling, 5 to 10 min.	Colors cementite, but not carbides high in chromium; in tungsten steels, iron-tungstide (Fe_2W) and iron-tungsten-carbide (Fe_3W_3C) are colored, but tungsten carbide is unaffected; attacks sulfides.
No. 4 Ferricyanide solution	Potassium ferricyanide Potassium hydroxide H_2O	10 g. 10 g. 100 ml.	May be used cold, but preferably hot; should be freshly made; time, 5 to 10 min.	Darkens carbide containing chromium; carbides and tungstides in tungsten and high-speed steels. At room temperature colors ternary carbides (Fe_3W_3C or Fe_4W_2C) in a few seconds, iron tungstide (Fe_2W) in several minutes, and barely colors cementite.
No. 5. Hydrogen peroxide and sodium hydroxide	H_2O_2 10 per cent NaOH, aqueous solution	10 ml. 20 ml.	Use fresh; etch 10 to 12 min.	Darkens iron tungstide in carbon-free iron-tungsten alloys. When carbon is present this solution darkens the compound ($FeW+WC$?) in proportion to the amount of carbon present; tungsten carbide is darkened.
No. 6 Stead's reagent	Cupric chloride Magnesium chloride HCl (conc.) H_2O Ethyl alcohol	1 g. 1 g. 1 ml. 20 ml. 100 ml.	Dissolve the salts in the least possible quantity of hot water; etch for about a minute; should be used with discrimination.	For showing segregation of phosphorus; copper tends to deposit first on areas poorer in phosphorus.
No. 7. Fry's micro-reagent	HCl (conc.) H_2O Cupric chloride Ethyl alcohol	40 ml. 30 ml. 5 g. 25 ml.	Time, about 10 sec.	To reveal strain lines and precipitation effects in "aged" steel. Requires careful examination.
No. 8. Mixed acids in glycerol	Glycerin HNO_3 (conc.) HCl (conc.) Acetic acid (28 per cent)	3 parts 1 part 2 parts 1 part	Time, about 30 sec. or longer; method of alternate polishing and etching should be used.	For 18 per cent chromium, 8 per cent nickel stainless steel; also for structure of iron-chromium base alloys containing aluminum, tungsten, vanadium, manganese, nickel and molybdenum [93].
No. 9. Chrome-regia	HCl (conc.) Chromic acid (10 per cent)	25 parts 5 to 50 parts	The activity of this solution is controlled by the amount of chromic acid.	For 18 per cent chromium, 8 per cent nickel stainless steel [93].
No. 10. Ferric chloride	Ferric chloride HCl (conc.) H_2O	5 g. 50 ml. 100 ml.	Time, about a minute.	For austenitic nickel-steels [93].

TABLE 1 (*Continued*)

Etching Reagent	Composition		Remarks	Uses
No. 11. Marble's reagent	Copper sulfate HCl (conc.) H_2O	4 g. 20 ml. 20 ml.	May also be used hot; time about a minute.	For structure of stainless steel, particularly to reveal extent of carbide precipitation in 18 per cent chromium, 8 per cent nickel steel; total depth of nitrided case [93].
No. 12. Copper sulfate and cupric chloride	H_2O $CuSO_4$ $CuCl_2$ $MgCl_2$ HCl (conc.) Dilute to 1000 ml. with 95 per cent ethyl alcohol.	100 ml. 1.25 g. 2.5 g. 10 g. 2 ml.	Chemicals should be accurately weighed. Time, about 30 sec. or less to a minute.	For showing total depth, structure, and various zones of nitrided steels.
No. 13. Ferricyanide solution	Potassium ferricyanide Potassium hydroxide H_2O	1 to 4 g. 10 g. 10 ml.	Use a freshly made boiling solution for 15 min.	Shows difference between carbides and nitrides; cementite is blackened, pearlite is turned brown, and massive nitrides remain unchanged.
No. 14. Neutral sodium picrate	1 per cent neutral sodium picrate solution.		Wash salt well with alcohol to remove excess picric acid or alkali; immerse in boiling solution for 20 min.	Darkens iron tungstide in high speed steel but not the complex carbide; darkens iron-phosphide in cast iron but not cementite.
No. 15. Chromic acid and heat tinting	8 per cent chromic acid, followed by heat tinting		Etch first in picric acid, then for 1 min. in chromic acid; heat tint by placing specimen face up on a hot plate heated to about 250° C. (500° F.) for about a minute.	Distinguishes between iron-phosphide and cementite in the phosphide eutectic of cast iron; iron-phosphide is colored darker.
No. 16. Hydrofluoric acid	HF HNO_3 Glycerol	2 parts 1 part 2 to 4 parts	Time, about 1 min.	For structure of high silicon alloys of the duriron type.
No. 17. Iodine solution	0.1 *N* iodine solution Alcohol	1 part 10 parts	Time, 5 to 15 min.	For detecting silicon dissolved in iron; higher silicon areas more lightly etched.
No. 18. Electrolytic etching	Copper ammonium chloride H_2O Current density 0.5 amp. per sq. dm.	0.5 g. 100 ml.	Time, 30 min., repeated etching and polishing.	To develop etching pits in iron.
No. 19. Mixed acids.	HCl HNO_3	3 parts 1 part	Saturate with cupric chloride and let stand 20 to 30 min. before use. Swab.	For stainless alloys and others high in nickel or cobalt.
No. 20. Nitric and acetic acid	HNO_3 Acetic acid	6 parts 4 parts	Swab.	Same as for reagent No. 19.
No. 21. Nitric acid in nitrobenzol [94]	HNO_3 (conc.) Methyl alcohol Add 40 drops of above solution to 50 ml. nitrobenzol.	20 ml. 80 ml.	Immerse specimen about 5 to 15 sec., rinse in alcohol, swab with concentrated NaOH to remove film, rinse in alcohol. Use only anhydrous acid and alcohol in reagent.	For detecting cementite, particularly in silicon steels. Used instead of reagent No. 3.

TABLE I

Refcrence No.	Now is	
93	(4)	**J. R. Villella "The Polishing and Etching of Iron Chromium and Iron—Chromium—Nickel Alloys", Proc. A. S. T. M. Vol. 84, Part 1, p. 193, (1934).**

employed in order to develop proper contrast or obtain good coloration which the constituents presents. For example, copper and phosphor bronze can be very beautifully colored if the peroxide-ammonia etch is followed by an electrolytic etch for 2-5 seconds. If this procedure is used the etched surface must not be swabbed or blotted dry but must be dried quickly by immersing preferably in absolute alcohol (95% will do) or a hot air blast. An electric hair drier works well for drying specimens where no regular air line is available.

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THE alloys of copper with manganese, silicon, beryllium, etc. are not well etched as a rule by ammonia plus peroxide but can be satisfactorily etched with the bichromate etch. The bichromate etch can also be used for leaded brass rods, Tobin bronze and if brasses containing beta have been etched with the bichromate etch, the beta may be darkened by following with a weak Grards reagent.

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THE writer has used the polish attack method with good results. Essentially the method consists of very lightly polishing on a parchment pad moistened with a suitable etching reagent. If parchment is not available a thin broadcloth may be used, the main precaution being that the pad be firm and not too soft or the grain boundaries may become accentuated by being rounded off.

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HUDSON recommends magnesia as a polishing abrasive during polish attack but the writer has obtained good results by just applying the ammonia after the rouge polishing has been carried far enough so that etching may be next performed.

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DURING polish attack the progress of the etch must be carefully followed in order to avoid broadening the grain boundaries and rounding the edges of the grains. For copper a 5% solution of concentrated ammonia in water gives good results.

FOR polish attack on steel a 2% solution of ammonium nitrate in water is used. Table 2 lists the various reagents suitable for etching copper.

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TABLE 2—ETCHING REAGENTS FOR COPPER AND ITS ALLOYS.

Etching Reagent	Composition		Remarks	Use
No. 1. Ammonium hydroxide - hydrogen peroxide	NH_4OH (sp. gr. 0.88) H_2O H_2O_2 (3 per cent)	5 parts 5 parts 2 to 5 parts	Peroxide content varies directly with copper content of alloy to be etched. Immersion or swabbing for about 1 min. Fresh H_2O_2 is desirable for good results.	Generally used for copper and many of its alloys. Film on etched aluminum bronze removed by weak Grard's solution.
No. 2. Ammonium hydroxide (60,61)	Dilute solutions.		Immersion.	Polish-attack etching of brass and bronze.
No. 3. Ammonium hydroxide - ammonium persulfate (61)	NH_4OH H_2O $(NH_4)_2S_2O_8$ (2.5 per cent solution)	1 part 1 part 2 parts	Immersion.	Polish-attack of copper and some alloys.
No. 4. Ammonium persulfate	$(NH_4)_2S_2O_8$ H_2O	10 g. 90 ml.	Use either cold or boiling. Immersion.	Copper, brass, bronze, nickel silver, aluminum bronze.
No. 5. Chromic acid	Saturated aqueous solution (CrO_3).		Immersion or swabbing.	Copper, brass, bronze, nickel silver (plain etch).
No. 6. Chromic acid - hydrochloric acid (53)	CrO_3 (10 to 15 per cent) HCl	50 ml. 1 to 2 drops.	Add HCl at time of use. Immersion.	Same as reagent No. 5. Color by electrolytic etching or $FeCl_3$ reagents.
No. 7. Chromic acid - nitric acid (55)	HNO_3 (conc.) H_2CrO_4 H_2O or HNO_3 H_2CrO_4 H_2O	50 ml. 20 g. 30 ml. 5 ml. 20 g. 75 ml.	Immersion.	Aluminum bronze: film from polishing removed by 10 per cent HF.
No. 8. Copper ammonium chloride - ammonium hydroxide (52)	10 per cent aqueous solution of copper ammonium chloride plus NH_4OH to neutral or alkalinity.		Immersion. Wash specimen thoroughly.	Best for darkening large areas of beta in alpha-beta brass. Copper, brass, nickel silver.
No. 9. Ferric chloride (52,54,62)	Parts: $FeCl_3$ / HCl / H_2O 5 / 50 / 100 19 / 6 / 100 5 / 10 / 100 25 / 25 / 100 1 / 20 / 100 8 / 25 / 100 10 / 1 / 100 3 / 10 / 100		Immersion or swabbing. Etch lightly or by successive light etches to required results. Grard's No. 1. Grard's No. 2. Plus 1 part CrO_3. Plus 1 part $CuCl_2$ and 0.05 part $SnCl_2$.	Copper, brass, bronze, aluminum bronze, darkens beta in brass; gives contrast following bichromate and other etches.
No. 10. Nitric acid (60)	Various concentrations.		Immersion or swabbing.	Deep etching.
No. 11. Potassium bichromate (52,53)	$K_2Cr_2O_7$ H_2SO_4 (sp. gr. 1.84) NaCl (saturated solution) H_2O	2 g. 8 ml. 4 ml. 100 ml.	NaCl can be replaced by 1 drop HCl to 25 ml. solution added just before using. Immersion.	Copper, copper alloys of beryllium, manganese, silicon, nickel silver and bronze. Followed by $FeCl_3$ or other contrast etch.
No. 12. Electrolytic etch (52,56,60,61)	$FeSO_4$ NaOH H_2SO_4 H_2O	30 g. 4 g. 100 ml. 1000 ml.	Use 0.1 amp. at 8 to 10 v. Generally not over 15 sec. Do not swab surface after etching.	Darkens beta in brass, gives contrast after H_2S etch. Nickel silver, bronze and other alloys.

Table II. Etching Reagents for Copper and its Alloys. ✦ ✦ ✦ ✦ ✦

TABLE II

Reference No.	Now is	
60	(5)	C. H. Desch "Metallography", Longmans, Green & Co., New York (1913).
61	(6)	O. F. Hudson "Etching Reagents and Their Application", Jr. Inst. Metals (British) Vol. 13, 193, (1915).
53	(7)	J. R. Villella "Delving Into Metal Structures", The Iron Age, Vol. 117, p. 261, 834, 903 (1926).
55	(8)	Jerome Strauss "Etching Aluminum Bronze", Chem. Met. Eng. Vol. 28, No. 19, p. 852 (1923).
52	(9)	C. H. Davis "National Metals Handbook", 1933, p. 1231.
54	(10)	H. B. Pulsifer "Smoothing and Etching Cupro-Nickel, Bronze, Brass and Steel", Trans. Inst. Metals Division A. I. M. M. E. p. 291 (1929).
62	(11)	W. Rosenhain "Introduction to the Study of Physical Metallurgy", D. Van Nostrand Co., Inc., New York (1914).
56	(12)	F. Adcock "Internal Mechanism of Cold Work and Recrystallization", Jr. Inst. Metals (British) Vol. 27, p. 74 (1922).
	(13)	G. W. Pirk "The Technique of Examining Metals Under the Microscope, Part I", General Electric Review, Vol. XXVIII, No. 8, p. 573, (1925).
	(14)	G. W. Pirk "The Technique of Examining Metals Under the Microscope, Part II", General Electric Review, Vol. XXVIII, No. 11, p. 800 (1925).

ELECTROLYTIC etching may also be used. Among the reagents found suitable for copper and the brasses are dilute ammonium nitrate, very dilute acids or ammonia. For the bronzes dilute sodium thiosulphate is satisfactory and dilute sulphuric acid to which hydrogen peroxide has been added is recommended for copper nickel alloys. The specimen is made the anode in a solution of the electrolyte either by suspending it by a platinum wire (in the case of copper or copper wire may be used) or holding it in tongs wired to the positive pole of a battery. (See F. Adcock "The Electrolytic Etching of Metals,—Jr. British Inst. Metals 1921, No. 2, Vol. XXVI, page 361).

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THE time required for etching copper increases with the amount of annealing given the material, and decreases with the degree of cold working.

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Macroscopic Etching

IT is frequently necessary to obtain some conception of the gross or macroscopic details of a casting, forging or other metallic article. This examination is generally performed with the unaided eye or at very low magnification.

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IN most instances the high polish required for microscopic examination is not required. It is usually sufficient to use a smoothly machined surface, such as that produced by a shaper using a sharp tool and light to medium cut with a fine feed. The exact surface, however, is determined by the purpose of the examination of the etching reagent which is to be used.

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WHEN examining iron and steel for surface defects such as seams, laps, fins, grinding cracks, etc., special preparation is not needed, since the etching reagent will remove scale, etc. For revealing defects in the interior of a bar a section must be prepared by cutting through the metal at the place where it is desired to perform the examination. When using the HC1 etch one part of commercial hydrochloric acid is used to one part of water and a machined surface is sufficient. Some reagents, however, such as Humfrey's, LeChatlier's; ammonium persulphate, etc., require a well ground and polished surface for best results.

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WHEN using the 50/50 HC1 water solution for steel, best results are obtained by using a fresh solution each time. The solution is used at about 160 deg. F. and is used under a hood since the fumes are very corrosive. Before proceeding to etch the specimen it should be carefully washed in soap and water, or gasoline to remove grease and dirt and then heated to 160 deg. F. in hot water. If this procedure is adhered to it will be much easier to duplicate conditions each time, since both the specimen and the etchant will be at the same temperature. This gives much better control of the time element than if the cold steel is put into the hot acid.

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THE actual time of etching varies for different steels and for the same steel in different conditions. In the annealed conditions the time may vary from 15 minutes for the plain carbon steels to 45 or 60 minutes for the highly alloyed steels such as the nickel—chromium, nickel, chrom-vanadium, tungsten and high speed steels.

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AFTER the specimen is etched it should be removed and washed entirely free from acid in running water. The black "smut" deposited should be thoroughly scrubbed off with a stiff bristled brush.

TABLE 3—ETCHING REAGENTS FOR MACROSCOPIC EXAMINATION OF IRON AND STEEL.

Etching Reagent	Composition		Remarks	Use
No. 1. Hydrochloric acid	HCl (conc.) H_2O	50 ml. 50 ml.	Used hot or boiling for about 10 to 15 min. depending on the steel.	Showing segregation, porosity, cracks, depth of hardened zone in tool steel, soft spots, etc.
No. 2. Mixed acid	HCl (conc.) H_2SO_4 (conc.) H_2O	38 ml. 12 ml. 50 ml.	Recommended by Yatsevitch (19): to be used as above for from 15 to 45 min.	Same as for reagent No. 1: works well for stainless steel.
No. 3. Nitric acid	HNO_3 (conc.) H_2O	25 ml. 75 ml.	Used cold for large surfaces such as split ingots which cannot conveniently be heated.	Same as for reagents Nos. 1 and 2.
No. 4. Ammonium persulfate	$(NH_4)_2S_2O_8$ H_2O	10 g. 90 ml.	Surface should be rubbed with absorbent cotton during etching.	To bring out grain structure in cases of excessive grain growth, recrystallization at welds, etc.
No. 5. Stead's reagent	Cupric chloride Magnesium chloride HCl (conc.) Alcohol	2.5 g. 10.0 g. 5 ml. Up to 250 ml.	The salts are dissolved in the HCl with the addition of the least possible quantity of hot water.	To bring out phosphorus-rich areas and phosphorus banding.
No. 6. Fry's reagent	Cupric chloride HCl (conc.) H_2O	90 g. 120 ml. 100 ml.	Most useful for mild steel, particularly bessemer steel; before etching, sample should be heated to 200 to 250 C. (302 to 482 F.) for 5 to 30 min., depending on the condition of the steel; during etching the surface should be rubbed with a cloth soaked in the etching solution; wash in alcohol or rinse in HCl (1:1) after etching to prevent deposition of copper.	To show up strain lines due to cold work.
No. 6A. Fry's reagent	Cupric chloride HCl (conc.) H_2O	45 g. 180 ml. 100 ml.	Same as for reagent No. 6 but modified by Wazau: may give more contrast; specimen can be washed in water without depositing copper.	Same as for reagent No. 6.
No. 7. Nital	HNO_3 Ethyl alcohol	5 ml. 95 ml.	Etch 5 min., followed by 1 sec. in HCl (10 per cent).	To determine cleanness and to increase contrast.

Table III. Etching Reagents for the Macroscopic Examination of Iron and Steel. ✦ ✦

TABLE III

Reference
No. Now is

19 (15) M. G. Yatsevitch "Essential Factors in Conducting Macroetching Test Under Usual Practical Conditions of Production Work", Trans. A. Soc. Steel Treating, Vol. 21, p. 310, (1933).

(16) F. F. Lucas "On the Preparation of Iron and Steel Specimens for Microscopic Examination", Trans. Am. Soc. Metals, Vol. XXIV, p. 1, (1936).

THE specimen may be blotted dry after washing or dried by an air blast or live steam. If the specimen is to be preserved for some time it should be completely freed from acids by placing in plain boiling water or boiling water containing a little soda and then rinsed several times in hot water. To give permanent protection to the surface it should be coated with transparent lacquer or collodium.

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TABLE 3 gives a rather complete list of the etching reagents used in the macro-examination of ferrous materials.

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THESE reagents are used to reveal a number of defects, such as chemical and physical, non-homogeneity, cracks, porosity, segregation and seams. Different soltuions reveal different defects; for example, ammonium persulphate brings out grain boundaries, Stead's reagent phosphorous bands, Fry's reagent strain lines, etc. If the sample is to be photographed the contrast can be increased by coating the surface with a thin film of glycerine.

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COPPER is treated in much the same way as steel when preparing the specimen for macroscopic examination. The surface may also be prepared by grinding to obliterate saw marks and then rough polishing or on a shaper. The reagents used for the macro-etching of copper and its alloys are those generally used for micro-etching, namely, 30-50% nitric acid, chromic acid, ferric chloride, ammonium persulphite and potassium bichromate. The specimen may be immersed in the solution or swabbed with cotton dipped in the etchant. As in steel, the surface should be thoroughly freed from any traces of etching reagent.

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Sulphur Printing

ALTHOUGH this is not strictly a method of etching it should be described since it is a macroscopic method for revealing surface segregation and the size and distribution of the sulfide particles.

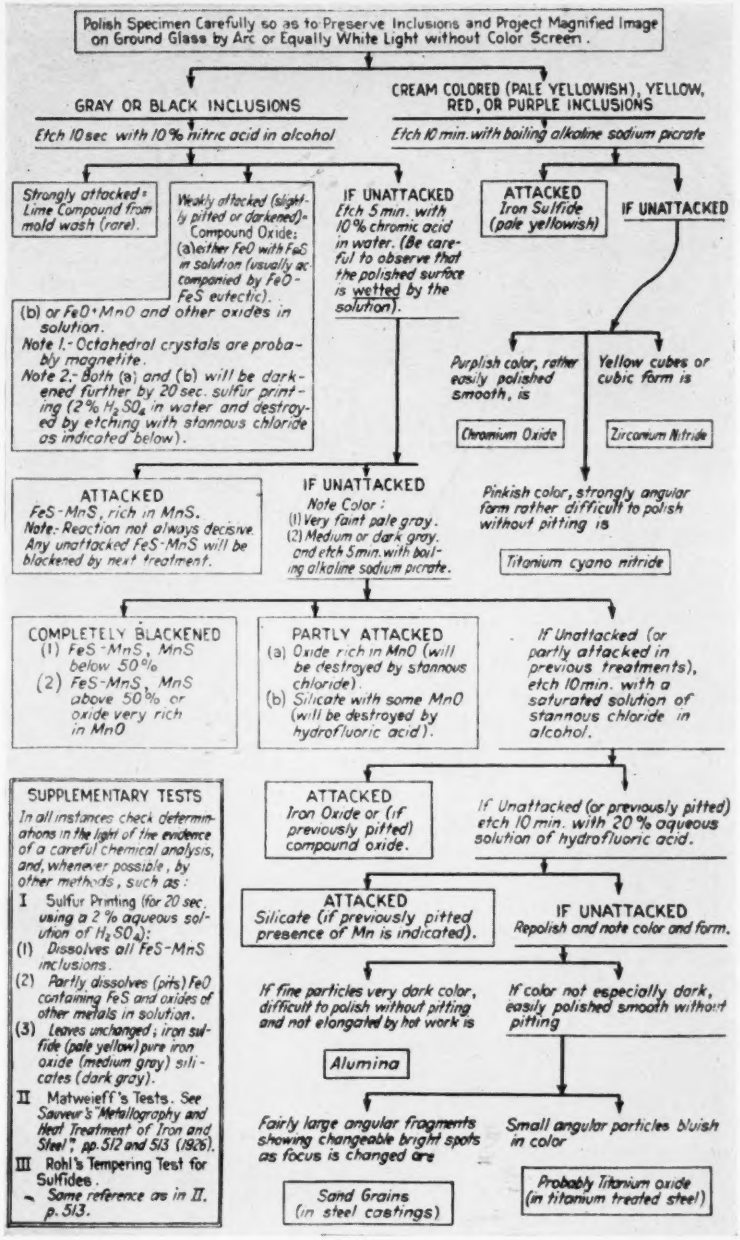
Polish Specimen Carefully so as to Preserve Inclusions and Project Magnified Image on Ground Glass by Arc or Equally White Light without Color Screen.
GRAY OR BLACK INCLUSIONS
CREAM COLORED (PALE YELLOWISH), YELLOW, RED, OR PURPLE INCLUSIONS
Etch 10 sec with 10% nitric acid in alcohol
Etch 10 min. with boiling alkaline sodium picrate
Strongly attacked = Lime Compound from mold wash (rare).
Weakly attacked (slightly pitted or darkened) = Compound Oxide: (a) either FeO with FeS in solution (usually accompanied by FeO-FeS eutectic).
(b) or FeO+MnO and other oxides in solution.
Note 1.- Octahedral crystals are probably magnetite.
Note 2.- Both (a) and (b) will be darkened further by 20 sec. sulfur printing (2% H_2SO_4 in water and destroyed by etching with stannous chloride as indicated below).
IF UNATTACKED
Etch 5 min. with 10% chromic acid in water. (Be careful to observe that the polished surface is wetted by the solution).
ATTACKED
Iron Sulfide (pale yellowish)
IF UNATTACKED
Purplish color, rather easily polished smooth, is
Chromium Oxide
Yellow cubes or cubic form is
Zirconium Nitride
ATTACKED
FeS-MnS, rich in MnS.
Note:- Reaction not always decisive. Any unattacked FeS-MnS will be blackened by next treatment.
IF UNATTACKED
Note Color:
(1) Very faint pale gray.
(2) Medium or dark gray.
and etch 5 min. with boiling alkaline sodium picrate.
Pinkish color, strongly angular form rather difficult to polish without pitting is
Titanium cyano nitride
COMPLETELY BLACKENED
(1) FeS-MnS, MnS below 50%
(2) FeS-MnS, MnS above 50% or oxide very rich in MnO
PARTLY ATTACKED
(a) Oxide rich in MnO (will be destroyed by stannous chloride).
(b) Silicate with some MnO (will be destroyed by hydrofluoric acid).
If Unattacked (or partly attacked in previous treatments), etch 10 min. with a saturated solution of stannous chloride in alcohol.
SUPPLEMENTARY TESTS
In all instances check determinations in the light of the evidence of a careful chemical analysis, and, whenever possible, by other methods, such as:
I Sulfur Printing (for 20 sec. using a 2% aqueous solution of H_2SO_4):
(1) Dissolves all FeS-MnS inclusions.
(2) Partly dissolves (pits) FeO containing FeS and oxides of other metals in solution.
(3) Leaves unchanged; iron sulfide (pale yellow) pure iron oxide (medium gray) silicates (dark gray).
II Matweieff's Tests. See Sauveur's "Metallography and Heat Treatment of Iron and Steel", pp. 512 and 513 (1926).
III Rohl's Tempering Test for Sulfides.
- Same reference as in II. p. 513.
ATTACKED
Iron Oxide or (if previously pitted) compound oxide.
If Unattacked (or previously pitted) etch 10 min. with 20% aqueous solution of hydrofluoric acid.
ATTACKED
Silicate (if previously pitted presence of Mn is indicated).
IF UNATTACKED
Repolish and note color and form.
If fine particles very dark color, difficult to polish without pitting and not elongated by hot work is
Alumina
If color not especially dark, easily polished smooth without pitting
Fairly large angular fragments showing changeable bright spots as focus is changed are
Sand Grains (in steel castings)
Small angular particles bluish in color
Probably Titanium oxide (in titanium treated steel)

Table IV. Methods for Identification of Inclusions in Iron and Steel. (By Campbell and Comstock, Modified by Wöhrman.)

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THE process is carried on as follows. The specimen is pressed against a piece of matte photographic paper which has been soaked for 2-3 minutes in 2-10% solution of sulphuric acid in water. From a few seconds to a minute or two of contact may be required depending on the sulfur content. Yellow or brown specks indicate the presence of sulphides. The prints are then fixed in the ordinary photographic hypo, washed in water and dried. A second but paler print may be obtained from the same surface, but it is better to regrind it. Transparent silver bromide paper may be used when it is necessary to make a number of prints. The prints are made using the ordinary contact process and regular photographic paper. At various times objections have been raised against the sulphuric acid method in the grounds that it does not distinguish between sulphides and phosphides. Royen and Am-

(*Please turn to page 462*)

Manufacture of Manila Rope Insulating Paper

By James F. Adams,
Vice President & General Manager, John A. Manning Paper Co., Inc.,
Troy, N. Y.

An interesting manufacturing process showing the conversion of discarded Manila ship cable into a product highly useful to the wire and electrical industries. ✦ ✦ ✦ ✦ ✦ ✦

BEFORE describing the manufacture of Manila rope papers, we will start with a brief description of the raw material which makes possible the development of the highly valued characteristics of the finished product.

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MANILA fibre is obtained from the Abaca plant, a species of wild banana grown chiefly in the Philippine Islands. Efforts to grow it elsewhere have met with little success. The botanical name of the fibre is Musa Testilis. The Abaca plant bears a fruit similar to the banana of commerce, but smaller and non-edible. The plant grows to a height of 20-25 feet, the trunk consisting of twelve to twenty stalks which spread out as they go upward. The fibre is extracted from the leaf stalks and not from the long leaves, as is the case with sisal fibre.

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FROM the time the young shoots are set out on the plantation, eighteen months must elapse before the plant attains maturity. The productiveness of the Manila plant is offset by the large amount of space it requires for growth, it being not unusual for five acres to yield only one ton of finished fibre at a cutting. Growth is best promoted on a soil composed of volcanic ash, plenty of water but quick drainage being requisites. For this reason, the best fibre is grown on the sides of hills or mountains.

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IN order to secure fibre of the best quality, the cutting must take place at just the proper time, which is the period between the flower and the development of the fruit. The task of extracting the fibre is performed by native labor in a very crude way, no machine having yet been devised to accomplish it satisfactorily. After the plant has been cut down, thin, fine edges are first removed and set aside. These provide a very silky fibre that is woven by the native women into a thin cloth of great strength and durability.

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THE next operation is the drawing by hand of each leaf stalk under a saw-edged knife, to remove pulp and separate the fibres. This is followed by washing of the fibre and drying in the sun. After this, it is taken to a warehouse and graded by Government inspectors into the numerous commercial grades. A standard bale of any given grade weighs about 270 pounds. Generally speaking, the finest fibre is nearest the center of the stalk. Such factors as strength, color, fineness, and length, determine the final grading. The difference in price between the extreme grades amounts to several hundred percent. It is in the form of these bales carefully marked as to grade, that the rope manufacturer receives his Manila fibre. Following inspection of the bales, the fibre goes through various combings to straighten, clean and soften the fibre. It is then twisted into a yarn and several yarns formed into a strand.

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THE next step is the laying of the strands into a rope. Three or four strands, depending upon whether three or four strand rope is being made, pass simultaneously through the laying machine which twists or lays the strands

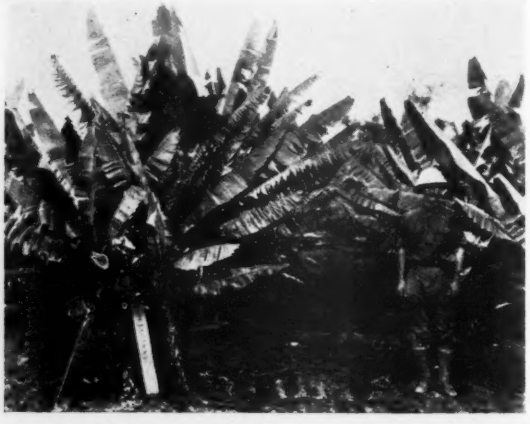

Fig. 1. Abaca Plant. ✦ ✦ ✦ ✦ ✦

Fig. 2. Fibre Extraction. ✦ ✦ ✦ ✦ ✦

Fig. 3. Cutting Rope.

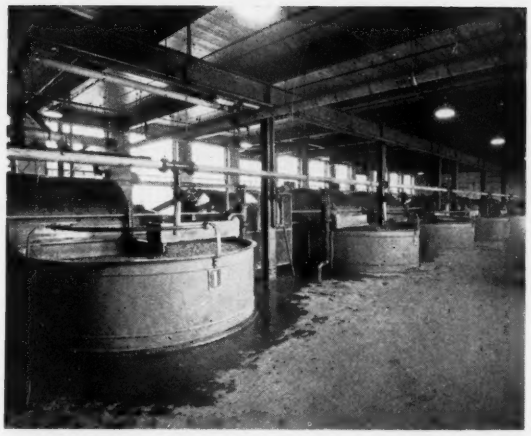

Fig. 4. Rotary Filling Floor.

into rope. As the rope leaves this machine it is wound onto a reel, from which it is later removed, ready to be burlapped for shipment.

✦ ✦ ✦

Insulating Papers

AFTER the rope has exhausted its useful life, the fibre of which it is composed is eminently suited to the manufacture of papers where great strength, long life, and maximum pliability are some of the requisites. During the last ten to twenty years there has been a continuous development of manufacturing plant and process, directed to the goal of an insulating paper of maximum purity whose strength approaches the tremendous strength of the unit Manila fibres of which the paper is composed.

✦ ✦ ✦

THE first step in the manufacture of Manila Rope Insulating Papers is the collection from ports all over the world of the Manila rope discarded by ships, etc. as no longer serviceable. Such rope is bought under very strict purchasing specifications, which cover the diameter of the rope, degree of oil contamination, exclusion of foreign fibres, and many other factors.

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UPON receipt of the rope at the paper mill it is carefully inspected in a preliminary way and then taken to the cutting department where the ropes composing the individual bales are given a final inspection and classification. The cleanest and finest fibred portions are cut for insulating paper, while the less attractive grades are set aside for papers that do not require the same degree of cleanliness and freedom from coarse fibres.

✦ ✦ ✦

THE cutting process chops the rope into lengths of two or three inches, which separate into the individual fibres in the later processing. Samples of the cut fibre are taken throughout the cutting operation and moisture tests made on each shipment. Rope is purchased on a definite moisture content basis, a premium or deduction being applied in case of deviation from standard.

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FROM the cutters, the rope travels on a conveyor belt to a duster, which partially opens up the strands and allows dust to drop through a screen. The fibre next passes over a magnetic roll to insure removal of residual metallic articles, and is then worked through a pneumatic system which separates dirt, dust and the strands that have not been untwisted. The clean, disintegrated fibres are then baled in advance of mill requirements. When required for papermaking, the clean dusted, cut fibre is forked into large, horizontal rotary cookers. Each rotary cook-

Fig. 5. Beater Room.

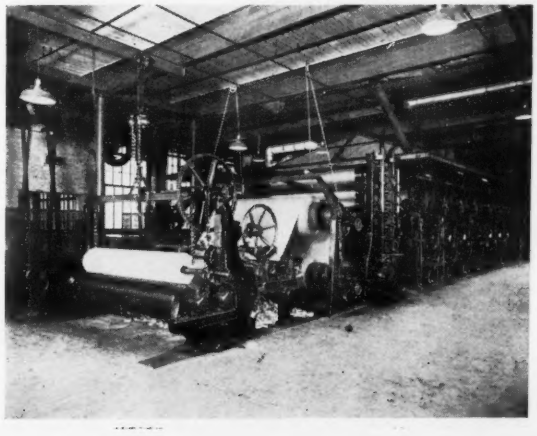

Fig. 6. Dry End Paper Machine.

er holds about 6000 pounds of this fibre. The cooking is done in a lime or lime and soda ash, or caustic soda solution under 0-40 pounds of steam pressure. The cooking operation takes 4-6 hours, during which time the large cooking drum is steadily revolved at a slow rate.

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THE object of cooking is to clean the fibre of all dirt, grease and other foreign material, and also to remove the resinous and ligneous matter which is part of the composition of the fibre. The removal of the resinous and ligneous matter leaves pure cellulose, adds to the durability of the ultimate paper, and also helps to free the unit fibres contained in the fibre bundles. An individual fibre as received by the rope maker is actually a bundle of fine, silky unit fibres held together by ligneous matter. Paper manufacturers make use of the ultimate or unit fibres.

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THE rotary cooker is next blown off which removes the cooking liquor now contaminated by resinous soaps, oil, dirt, etc. This is followed by the dumping of the stock on a concrete floor to permit the draining off of any residual liquor.

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AFTER the stock has drained for a number of hours, it is conveyed to the beaters. The beaters are equipped with a washing attachment which permits of the continuous removal of dirty water. The washing operation is carried on for several hours, the stock being lightly beaten at the same time.

WHEN the washing has continued to a chemically determined end-point, it is stopped and beating of a more severe nature is carried on for several hours longer. The endpoint of the beating is determined by the length of the fibre and its ability to retain water (degree of hydration).

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THE stock is now dropped into a chest and run through an automatic consistency regulator to the machine chest, then through an automatic stock density regulator and finally to the Jordan refining engine. The effect of the regulators is to promote uniformity of gauge and weight in the finished paper. The Jordan engine is in effect much like a continuous high speed beater. Its function is to exercise a last minute control of a very responsive nature upon the length of the fibres. It also affects to some extent the hydration of the stock.

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THE dilute Jordan stock is run through a trough approximately 150 feet long by 6 feet wide, equipped with riffles to settle out particles of sand, etc. At a certain point in the trough a magnetic separator operates beneath the water to aid in the elimination of the most minute traces of iron and other fine metallic particles which are drawn down with the iron. At the end of the trough the stock passes through rotary screens to remove strings and flocculated lumps of fibre. Just before going to the paper machine, the suspension of fibres is subjected to a final purification by passage through high speed centrifugals.

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THE cylinder type paper machines in this industry consist of one or more cylinders covered with fine mesh screening, each rotating in a vat into which is introduced the suspension of fibre and water referred to above. A single ply paper employs one cylinder, double ply, two, etc.

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TH7 web of matted fibres built up on the cylinder screen face by the plating out of the fibres left behind as the water runs through the screen face, is removed from the screen by an endless belt of felt which presses against the screen face. If the paper is a two ply paper, the felt picks up a second ply from the next adjacent rotary screen (or cylinder mould, as it is more properly called). The web of paper so formed passes through one drying end of the machine, then through a set of calender rolls and is finally wound up in the form of standard paper mill rolls, to be shipped out in widths called for by the trade. Depending on the field in which the paper is to be used, it is made to conform to various electric specifications such as dielectric strength, capacity, power factor loss, etc.

✦ ✦ ✦

MUCH of the insulating paper is shipped out in narrow tapes which are known as pads, the slitting being done in the mill's own slitting department. The pads are shipped out in bundles contain-

(*Please turn to page 457*)

Fig. 7. Slitter Room.

Fig. 8. Research Laboratory.

Outstanding Personalities of the Wire Industry

T. F. Smith, Secretary and Assistant Treasurer, Oliver Iron & Steel Corp.

Theodore F. Smith, president, Keystone Wire Matting Co. and a director of Standard Steel Specialty Co., Beaver Falls, Pa., has been appointed secretary and assistant treasurer of Oliver Iron & Steel Corp. He also is former director in western Pennsylvania for the Federal Housing administration.

✦ ✦ ✦

C. R. Ellicott, General Manager, Cambria Plant of Bethlehem Steel

RECENT promotions within the Bethlehem organization, affecting **C. R. Ellicott** and **R. E. Hough** of the Cambria plant, Johnstown, Pa., have been made by the Bethlehem Steel Company, Bethlehem, Pa.

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C. R. Ellicott has been appointed general manager of the Cambria plant, Johnstown, Pa., succeeding the late L. R. Custer. Starting as a chemist in the laboratory of the Bethlehem, Pa., plant upon graduation from Lafayette College in 1908, Mr. Ellicott was later transferred to No. 1 open hearth, and in 1913, appointed superintendent. In 1915 he was made superintendent of Nos. 1 and 3 open hearths. From 1917 to 1922 he was superintendent of the hot metal division, comprising blast furnaces, open hearths Nos. 1 and 2, tool steel and merchant bars mills. In 1922 he was appointed superintendent of furnaces and alloy mills of the Lehigh division of the Bethlehem, Pa., plant and in October, 1928, he was transferred to the Cambria plant, Johnstown, Pa., as assistant general manager.

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R. E. Hough has been appointed assistant general manager. He was formerly superintendent of the Gautier mills, coming to the Cambria plant in 1929 after 22 years service at the Lackawanna plant.

MOSS A. KENT

Kent Appointed Manufacturing Director of General Cable Corp.

APPOINTMENT of Moss A. Kent as Manufacturing Director of General Cable Corporation has been announced recently. His office is at the Executive Headquarters of the Corporation, Graybar Building, 420 Lexington Avenue, New York.

✦ ✦ ✦

AFTER graduating from Princeton University in 1914 with an engineering degree, Mr. Kent became associated with the Rome Wire Company, Rome, New York, as operating engineer. Later becoming Factory Manager. After the formation of General Cable Corporation, he held successively positions of Division Factory Manager and Assistant General Works Manager.

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DURING the past several years, Mr. Kent has been active as Committee Chairman of N. E. M. A. and A. S. A. Committees formulating and promoting standardization in the electrical wire industry.

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Pittsburgh Steel Corp. Announces Changes in Personnel

Joseph H. Carter, formerly works manager at Sharon, Pa., for Sharon Steel Corp., has been named general superintendent of plants of Pittsburgh Steel Co.

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R. C. **Butler** has transferred from Sharon Steel Corp. to Pittsburgh Steel Co. as blast furnace superintendent.

✦ ✦ ✦

Homer C. Morrison, foreman of the rolling mill at Lowellville works, Sharon Steel Corp., has been named superintendent of the blooming and bar mill of Pittsburgh Steel Corp.

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Warren M. Fording

WARREN M. FORDING, 37, secretary to Tom M. Girdler, president and chairman, Republic Steel Corp., died in Cleveland, Aug. 13. Previous to coming to Cleveland with Mr. Girdler in 1929, Mr. Fording was secretary to R. J. Wysor, then general manager of Jones & Laughlin Steel Corp. He also had been connected with Diamond Coal & Coke Co. and Colonial Supply Co., both at Pittsburgh. He was born in Pittsburgh, and served overseas during the World war with the United States army.

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Charles Cawthorne

Charles S. Cawthorne, assistant treasurer of the American Steel and Wire Company, died recently in his home at Lake Bluff, Ill. Mr. Cawthorne had been in ill health since September 1934, when he was savagely beaten by three gunmen during a payroll robbery.

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BORN 62 years ago in Port Huron, Mich., Mr. Cawthorne attended college at Olivet, Mich. In 1901, he became cashier of the American Steel and Wire office in Waukegan, Ill. For the last 20 years he had been cashier and assistant treasurer in the Chicago office.

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HIS widow, a brother, Robert of Waukegan, and a sister, Miss Jennie Cawthorne of Port Huron, survive.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products In June, 1936 and June, 1935
(In gross tons)

	June 1936	May 1936	June 1935
Wire rods	3,317	3,183	2,368
Hoops, bands and strip steel	6,002	4,169	3,173
Plain black or galvanized iron or steel wire	4,069	4,772	4,364
Barbed wire and woven wire fencing	2,187	3,395	2,712
Woven wire screen cloth	94	79	119
Wire rope	231	283	414
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	399	326	335
Wire nails	448	786	644
Tacks	54	50	50
Other nails, including staples	149	242	160
Bolts, machine screws, nuts, rivets and washers	493	621	430
Total, these 11 classifications	17,443	17,906	14,769

Imports of Iron and Steel Wire into the United States
(In gross tons)

Concrete reinforcement bars	501	682	300
Hollow bars and drill steel	162	192	66
Wire rods	1,278	1,690	722
Barbed wire	557	1,069	2,344
Round iron and steel wire	420	480	488
Telephone and telegraph wire	1	.....	4
Flat wire and strip steel	274	261	97
Wire rope and strand	183	163	123
Other wire	64	85	40
Hoops and bands	979	2,373	2,517
Nails, tacks and staples	1,479	1,595	1,542
Bolts, nuts and rivets	16	80	56
Total, these 12 classifications	5,914	8,670	8,299

Exports of Insulated Wire and Cable, June, 1936

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Insulated iron or steel wire and cable	6,832	$ 1,429	734	$ 219
Rubber-covered wire	388,289	97,349	45,877	8,806
Copper weatherproof wire	72,170	10,508	35,194	6,364
Copper telephone cable	25,430	4,978	879	94
Other insulated copper wire	388,076	86,191	275,148	43,885
Nickel-chrome electric resistance wire	54,076	70,048	.....	.....
Total, these 6 classifications	934,873	$270,503	357,832	$59,368

Exports at Record Level for June —Imports Lower

SHIPMENTS of iron and steel products from the United States during June established a new modern record for that month when they aggregated (including scrap) 294,951 gross tons valued at $10,147,811 as compared with 286,333 tons valued at $6,993,087 in June 1935. Total exports during the corresponding month of last year were in excess of the May volume for the first time since 1930, and at the same time exceeded the June 1929 figure by about 10 percent. Because of a lower volume of scrap shipments during June of the current year, however, the 294,951-ton trade referred to was below the May total of 314,950 tons valued at $10,099,360.

AN encouraging aspect of the trade during the reviewed month was that shipments of non-scrap items amounted to 103,778 tons valued at $7,579,807, thereby registering striking increases of 50 percent in quantity and 64.5 percent in volume when compared with those made in May 1935. Compared with the previous month there were respective increases of 6.4 percent and 2.5 percent.

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OVERSEAS shippers supplied the United States with 40,323 gross tons of iron and steel products (excluding scrap) valued at $1,657,194 during June, thereby recording declines of 7.5 percent in quantity and 6.2 percent in value when compared with May receipts. Those totals, however, were considerably higher (31 percent and 25.4 percent, respectively) than those for the corresponding month of 1935.

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Exports Maintain High Level in June

COMPARING the June export trade (excluding scrap) with that for May, there were increases registered in 32 classifications, with declines recorded in 31, with the gains considerably more pronounced than the losses. Plain shapes followed the sharpest upward curve in rising 2,893 tons higher than its May total, followed by heavy rails (1,724 tons), hot rolled strip steel (1,235 tons), seamless casing and oil-line pipe (1,117 tons), skelp (829 tons), and tin plate (707 tons). The only declines of any consequence were those in 'other steel bars' (1,976 tons) and 'other plate' (1,285 tons).

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Canada Remains Leading Individual Market

CANADA maintained its position as the leading outlet (excluding scrap) when its widespread June purchases aggregated 31,232 tons, of which the outstanding items were skelp (6,017), plain shapes (4,200), tin plate (3,816), black steel sheets (3,731), 'other steel bars' (1,394), and 'other plate' (1,365). Soviet Russia's purchases totaled 6,791 tons, of which the chief items were black steel sheets (3,329), hot rolled strip steel (1,948), cold rolled strip steel (711), and terneplate (499). Next came the Philippine Islands (5,574 tons) whose trade was chiefly of galvanized steel sheets (1,970), tin plate (1,340), black steel sheets (352), 'other steel bars' (290), and sheet piling (251). Japan's trade of 5,377 tons was next, and the outstanding items were tin plate (2,320), wire rods (1,264), and heavy rails (609). Cuba followed with a trade involving 4,406 tons, for the most part made up of tin plate (549), barbed wire (317), plain shapes (254), and galvanized steel sheets (239). Brazil was the sixth market of importance, shipments totaling 4,319 tons going forward to that destina-

tion. The outstanding products were heavy rails (1,000), tin plate (995), plain wire (471), black steel sheets (454), barbed wire (753), and galvanized steel sheets (290). During the first half of 1936 the leading individual outlets for iron and steel products (excluding scrap) shipped from this country were Canada, 130,341 tons (93,489 tons in the corresponding period of 1935), Brazil, 34,713 tons, (23,015), the Philippine Islands, 33,527 tons (31,109), Japan, 28,829 tons (59,213), Mexico, 26,873 (32,941), Soviet Russia, 26,159 tons (16,881), China, 26,151 tons (18,897), and Cuba, 21,290 tons (18,937).

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Pig Iron Leading Import Item

CONTINUING in its role as the leading iron and steel import item from a tonnage standpoint, pig iron was received to a total of 16,793 tons, and came mostly from British India (6,829), the Netherlands (4,798), the United Kingdom (2,554), and Soviet Russia (861). Next was spiegeleisen (5,285 tons) practically all coming from Canada (4,712). Structural shapes followed with a total of 3,157 tons purchased for the most part from Belgium (1,932), France (910), and Germany (311). Bars, whether solid or hollow, made up the fourth item, the leading suppliers being Belgium (1,560), and Sweden (294). Ferro-manganese receipts aggregated 2,222 tons and the bulk thereof came from Norway (1,189), the Netherlands (517), and France (437). Next was 'other pipe' (1,526 tons) supplied principally by Germany (1,126), and Sweden (302).

✦ ✦ ✦

Sources of June Imports

BRITISH India—from the standpoint of tonnage—was the leading supplier of iron and steel to this country during June, its total trade (6,829 tons) being entirely of pig iron. Germany followed with a rather varied trade aggregating 5,828 tons, made up for the most part of nails, tacks, and staples (1,401), 'other pipe' (1,136), sheets, skelp, and sawplate (964), barbed wire (539), shapes (311), and pig iron (308). Belgium likewise had a varied trade amounting to 5,738 tons, of which the outstanding items were shapes (1,932), solid and hollow bars (1,560), 'other hoops' (685), concrete reinforcing bars (406), rails and track material (381), and sheets, skelp, and sawplate (380). Next was Canada (5,534 tons) whose trade was principally of spiegeleisen (4,712), and pig iron (694). The Netherlands sent in mostly pig iron (4,798), and ferro-manganese (517) in its total of 5,341 tons. Pig iron (2,554), and 'other hoops and bands' (196) were the outstanding products in the United Kingdom's share of 2,966 tons.

✦ ✦ ✦

CARD clothing receipts were upward during the reviewed month when they aggregated 41,537 square feet valued at $59,298, thereby registering increases of 12 percent in quantity and 16.3 percent in value when compared with May. The trade was covered by the United Kingdom (35,685

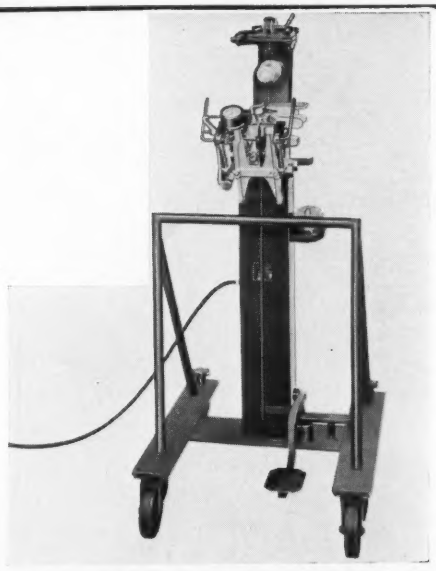
(*Please turn to page 456*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

CONTINUOUS IMPROVEMENT

MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone State 7468 General Office and Factory, Peoria, Ills.

A Review of Recent Wire Patents

No. 2,046,343, SCREW, Patented July 7, 1936 by Henry F. Phillips, Portland, Ore., assignor, by mesne assignments, to Phillips Screw Company, Wilmington, Del., a corporation of Del.

This screw is of the cruciform-slotted type, the slots converging downwardly to the axial center of the screw.

✦ ✦ ✦

No. 2,046,534, WIRE SCOOP, Patented July 7, 1936 by Benjamin H. Smith, Niles, Mich., assignor to Michigan Wire Goods Company, Niles, Mich.

Except for the handle, this wire scoop, particularly adapted for sifting ashes, handling vegetables, and the like, is constructed wholly of sections of bent wire.

No. 2,046,564, WIRE FABRIC FOR BEDSPRINGS AND OTHER ARTICLES, Patented July 7, 1936 by Joseph Laden, Brooklyn, N. Y., assignor to Samuel E. Schwartzman, Brooklyn, N. Y.

The inventor aims to provide a wire fabric, for the construction of bed springs, having a flat even surface so as to minimize wear upon the mattress.

✦ ✦ ✦

No. 2,046,839, SCREW, Patented July 7, 1936 by Henry F. Phillips and Thomas M. Fitzpatrick, Portland, Ore., assignors to Phillips Screw Company, Wilmington, Del.

The cross-shaped slots in the head of this screw have tapered side walls merging into a recess disposed substantially at the axial center of the screw.

✦ ✦ ✦

No. 2,046,883, CONCENTRIC FIELD COIL WINDER, Patented July 7, 1936 by Phil Robbins, Santa Rosa, Calif.

With this field coil winder, it is stated that a number of coils in one gang can be wound, even if these coils are of different sizes. The inventor makes use of a number of adjustable forms.

✦ ✦ ✦

No. 2,046,978, HOLLOW CABLE, Patented July 7, 1936 by Horace A. Staples, Plainfield, N. J., assignor to Phelps Dodge Copper Products Corporation, New York, N. Y., a corporation of Delaware.

The cable is composed of stranded, alternate hollow and solid wires, so arranged that each layer of strand is carried only on the solid wires of the underlying layer.

✦ ✦ ✦

No. 2,046,997, WIRE FEEDING DEVICE, Patented July 7, 1936 by Edwin Harley Boddy and Ethan W. Vars, Erie, Pa., assignors to General Electric Company, a corporation of New York.

This device is adapted for feeding welded electrodes, the jaw members making up a portion of the device, completely surround the electrode during the feeding.

✦ ✦ ✦

No. 2,047,271, INSULATED CABLE, Patented July 14, 1936 by Joseph A. Kennedy, Pawtucket, R. I., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware

So as to meet soil conditions, this inventor has provided an insulated cable having a wrapping of jute, pitch impregnated in the jute, and a seamless envelope of unmasticated vulcanized rubber (the residue of a water dispersion of latex, curable at the temperature be low the melting point of the pitch.)

✦ ✦ ✦

No. 2,047,374, CONTROL AND SAFETY SYSTEM FOR STRAND WORKING APPARATUS, Patented July 14, 1936 by Einer W. Larsen. Chicago, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of N. Y.

For use with wire drawing machines, the inventor has provided an assembly to coordinate the strand slackener with the take-up means.

✦ ✦ ✦

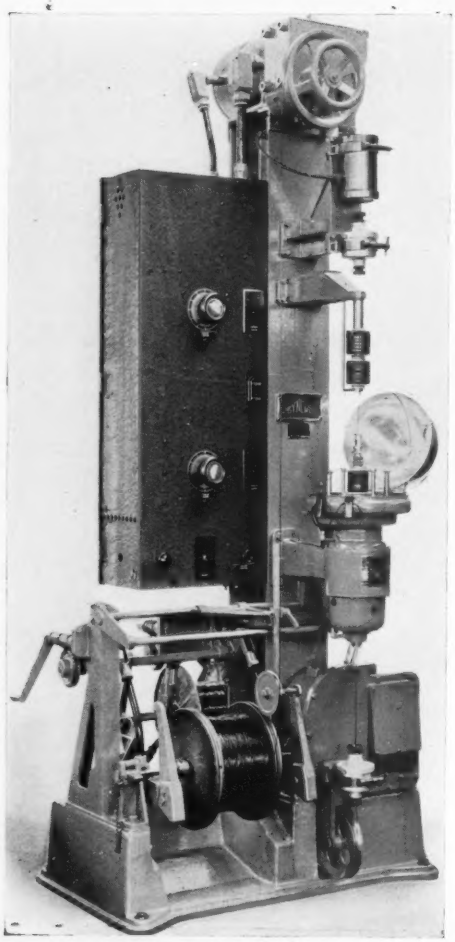
No. 2,047,411, WIRE SPRING FOR CUSHIONED SEATS, Patented July 14, 1936 by Morris Freund, Cleveland, Ohio.

The spring is of the flat type, comprising wire, and the inventor provides for resiliently counter-acting bending of the springs proportionate to their load.

✦ ✦ ✦

No. 2,047,667, SPRING CONSTRUCTION, Patented July 14, 1936 by Philip S. Braun, Los Angeles, Calif.

(*Please turn to page 452*)



SYNCRO

Each Syncro Insulating Machine has an individually driven and controlled Take-Up Unit assuring even distributing and correct tensions.

Syncro's direct motor drive allows for a wide selection of constant tensions ranging from 3 oz. to 18 lbs. and eliminates both soft spooling and the possibility of damaging the wire by elongation due to excessive tensions.

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'Round the World With the Wire Industry

German Wire Cartel

THE German wire cartel reports that during the first half of 1936, operations for the domestic market were 65.7% of the total possible capacity, compared with 58.3% last year, and for export were 71.2%, compared with 68.3% during the same period.

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German Wire Exports

MAY exports of wire amounting to 14,881 tons were 2,970 tons lower than April, and wire nail exports of 2,589, were 277 tons below April. June export figures are, however, expected to rise again due to the general improvement of the export business beginning with the second half of May. The improved export trade in wire products is still maintained. Imports are negligible and amount to only 789 tons of all wire products for May. The total exports for May of steel products, excluding scrap and wires, totaling 294,784 tons, were the highest since 1927.

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THE Government draft bills, which make construction of new wire and cable works dependent on a Government license to avoid overproduction, have been extended for another year.

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THE demand for rivets, both for domestic and export consumption, is very satisfactory, because ship and bridge builders are fully booked with orders.

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International Wire Rod Cartel

THE International Wire Rod Cartel, which expires the end of September, has been provisionally extended to the end of 1936. Reports that the cartel was extended to 1941 are, however, premature. It is nevertheless certain, that an extension beyond this date will meet with no difficulties. The demand for wire rods is quite satisfactory at present with unaltered prices of £ (gold) 4.10 basis. A few concessions have been granted to the Far Eastern markets not exceeding 2/9 sterling per ton. Heavy wire rods of thick diameters are still preferred.

NEGOTIATIONS have been started to include Roumania and Jugoslavia in the IWECO. These countries do not export wire products so that their acceptance would mean a regulation of market protection agreements.

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FRENCH wire producers have stopped the export of wire products, except to the Colonies. This is due to production costs which have been raised to such an extent after the recent increase in wages and other overhead expenses. The French firms prefer to close down part of their works instead of accepting export orders. The adverse effect upon Belgian production has not been felt yet, because Belgian production costs after last year's Franc devaluation have been extraordinarily low.

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OF the total wire export trade in 1934, approximately 39% was

TIGHTLY PACKED YET PERFECTLY BAKED—

Here is just one more saving available to you through Morrison rod bakers. Rod need not be stacked carefully or openly. Load all you can get on the truck, any way you want to put it there. The penetrating heat resulting from applying the Morrison recirculating forced convection principle brings every inch of rod to a uniform temperature amazingly quickly. Many Morrison units are replacing equipment three times their size—doing the same work on approximately one-third the fuel, in one-third the space—doing it better than it was ever done before.

Other Morrison equipment is designed for annealing, heat-treating, and galvanizing; tank and pot heating; and other industrial process heating applications utilizing the recirculating forced convection method.

MORRISON ENGINEERED

Morrison Engineering Company, Inc.

5005 EUCLID AVE. CLEVELAND, OHIO

'Round the World With the Wire Industry

handled by barter, compensation or clearing; in 1935 the total was 77%, and for 1936, about the same percentage. With rare exceptions, the industry is content with this agreement, which particularly in Latin America and the Balkans, led to a predominance of purchases in Germany.

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Proposed Steel Works for Southern Rhodesia

THERE is a possibility that a steel works will be established in **Southern Rhodesia** in the near future, writes Consul Hugh S. Miller, Johannesburg. A recent announcement by the Mayor of that city, indicated that "an important industry would be started." It appears, according to the local press, that it will be a steel works with London capital behind it. Further, it is understood that about $400,000 will be spent on the plant if it actually comes into being.

New German Stainless Steel Features Absence of Nickel

A NEW kind of stainless steel has been placed on the market by a well-known **German** iron and steel producer. The new product is claimed to possess all the essential properties of nickel-chrome steels without incorporating nickel in any proportion and is known as "Roneusil". Its composition includes 12 percent manganese and 8 to 9 percent chromium. It is lower priced than any of the popular kinds of nickel-chrome steels and consequently lends itself to some uses in which the old type stainless steel has been handicapped by its high price, it is stated.

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Ontario Wire Output Not Up to Expectations

PRODUCTION in the wire industry of Ontario thus far this year has not exceeded that for the corresponding period of last year, writes Vice Consul Adam Beaumont, Hamilton. This is stated to be disappointing to the industry which had expected it to be higher than in the previous year. It is to be noted, however, that the 1935 output was very much in excess of that in the three previous years.

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European Wire Mill Construction Activities

AMONG the wire mills under construction and rehabilitation in Europe at the present time are the following:

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A LARGE manufacturing plant in the Western part of Germany is considering a 40 wire installation for galvanizing iron and steel wire.

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A LARGE wire concern located in the Eastern part of Germany has under consideration a 16 wire installation for stripped and covered wire.

New Brazing Alloy Increases Applications

IMPROVEMENTS and refinements in manufacturing Phos-Copper brazing alloy have been announced by the Westinghouse Electric and Manufacturing Company. Increasing its field of application, the new processes include annealing and pickling to insure freedom of any carbonacious deposit on the surface which might interfere with the production of leak proof joints. This makes the new alloy especially suitable for applications such as refrigerator parts where leak proof joints are a necessity.

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AN alloy of phosphorus and copper developed to replace expensive silver solders, Phos-Copper has a relatively low melting point, high tensile strength and excellent penetration. Some of its other desirable properties include absolute uniformity of alloy, self fluxing properties for most applications, high ductility, high fatigue resistance, high corrosion resistance, high electrical conductivity, high fluidity at brazing temperature, and economical to use. Also, brazed joints may be electroplated or tinned.

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PHOS-COPPER is available in many sizes and shapes, including rod, ribbon, washers, strip, and other shapes. Standard rods are three feet in length with diameters as follows: 1/16", 3/32", 1/8", 3/16", 1/4". Ribbon is .015" thick by 1.25" wide. Other shapes for special applications are available.

✦ ✦ ✦

IT is applicable to all kinds of copper and copper alloy joints where strength, or gas and liquid tight joints are required, such as bus bar structures, copper tanks, cooling coils, electrical connections, radiators, refrigerators, terminal lugs, water heaters, copper piping, air conditioning systems, and copper smithing.

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PHOS-COPPER is applied essentially the same as soft solders, except Phos-Copper requires a higher temperature. It melts at 707° C., a temperature which can easily be obtained by an oxgy-acetylene torch, incandescent brazing or carbon arc. High fluidity at brazing temperatures makes the alloy easy to use. At brazing temperatures it flows freely over the surface, facilitating the brazing of hard-to-get-at joints. It is self fluxing when used on ordinary copper work where it is not necessary to secure gas or liquid tight joints.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested additional information will be supplied promptly. Simply address:

WIRE & WIRE PRODUCTS

17 East 42nd Street **New York City**

'Round the World With the Wire Industry

A Palatine wire mill is rebuilding a 30 wire stripped wire-galvanizing plant for the manufacture of high quality galvanized wire.

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AN Italian wire mill is building a combination plant for stripping and covered galvanized wire with 32 discs.

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A Dutch wire mill is building a 16 wire installation for stripping and galvanizing wire.

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A French wire plant is building a two-way, continuous, 40 strand wire alley, for galvanizing, stripping and covering of wire. The same plant will also include high quality galvanizing installations with continuous glowing process, for 18 strands.

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A WIRE plant located in the Saar basin is installing a fine wire galvanizing plant with continuous glowing process.

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ANOTHER fine wire galvanizing installation is being made in a plant located in the Western part of France while a Swedish wire plant is installing improvements in its fine wire galvanizing process.

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IN the central part of Germany one of the mills is installing a new plant for making wire anti-corrosive and in the southern part of Germany a new installation is going in for thick and fine wire.

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THE above information is furnished by Dr. Keller & Bohacek of Halle-Saale, Germany.

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WE are advised by Dr. Keller & Bohacek, Anti-Corrosive Co., Halle-Saale, Germany that at the present time and since October of last year there has been great activity in the reorganization and new construction of wire mills in Europe. They further advise that many of these mills are installing anti-corrosive and zinc-processing installations and state that such installations have been made by the following companies:

Soc. des Hauts Forneaux et Acieries de Differdange, St. Ingbert-Rumelange, St. Ingebert.

Forges & Acieries de Commercy, Commercy, (Meuse).

Soc. Metallurgique de Gorcy, Gorcy, (Meurthe & Moselle).

Trefileries & Laminoirs du Havre, L' Haure.

Trefileries Leon Bekaert, Sweveghem.

Sambre-Escaut, S. A., Hemixem.

Gutehoffnungshutte Oberhausen, A. G., Gelsenkirchen plant, etc.

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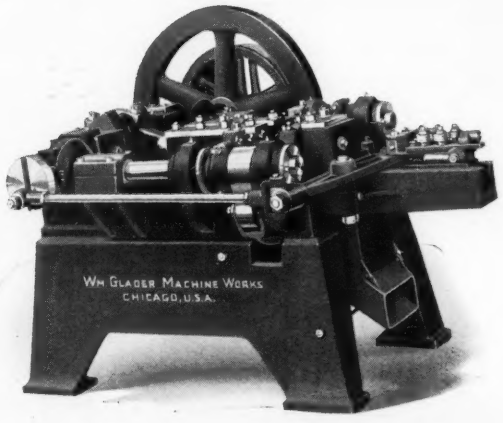
G. F. Wright Steel & Wire Company to Change Address

G. F. Wright Steel & Wire Company, 22 West Austin Ave., has leased a building at 1921 No. Jefferson St., to which its plant will be moved in the near future.

GLADER

HIGH SPEED WIRE NAIL MACHINE



Machines are built in nine sizes to cover a range of nails from 15 gauge 1/4" long to 3/8" diameter 12" long, including large head roofing nails.

A month's operation of one of our latest type machines will produce an average of more than 200 pounds of 8d common nails per hour.

These machines are well liked by operators, due to the fact that adjustments are easily made and can, in most instances, be made while the machine is in operation.

The performance of these machines, both as to production and low maintenance cost has led to their exclusive selection in all of the recent major nail making machine installations.

WM. GLADER MACHINE WORKS

210 N. RACINE AVE. CHICAGO, ILL.

All Wire Mill Men Are Invited to Attend
The Wire Association
1936 Meeting and Exhibition

At Cleveland, Ohio, October 19, 20, 21, 22, 23, 1936

In Association With the National Metal Congress

THE WIRE ASSOCIATION

Vice President
F. A. WESTPHAL
Superintendent, Wire Mills,
Sheffield Steel Corp.,
Kansas City, Mo.

President
RALPH K. CLIFFORD
General Superintendent,
Continental Steel Corp.,
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JOHN MORDICA
Supt., Rod and Wire Works,
Bethlehem Steel Company,
Sparrows Point, Md.

Vice President
E. W. CLARK
Mechanical Engineer,
Wire and Cable Section,
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Schenectady, N. Y.

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John C. Callaghan, Works Manager, Canada Works,
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E. W. Clark, Mechanical Engineer, Wire and Cable Section,
General Electric Co., Schenectady, N. Y.

F. A. Westphal, Supt., Wire Mills,
Sheffield Steel Corp., Kansas City, Mo.

R. S. Simmons, General Metallurgist,
Keystone Steel & Wire Co., Peoria, Ill.

R. E. Brown, President,
WIRE AND WIRE PRODUCTS, New York, N. Y.

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THE Wire Association serves as a technical society interested in the purely technical problems concerning the wire industry. The membership includes:

1. Manufacturers of wire, rod, strip, cold drawn shapes and tubing.
2. Manufacturers of insulated wire and cable.
3. Users of wire—Manufacturers and fabricators of wire products.
4. Manufacturers of machinery and supplies pertinent to the wire industry.

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IN addition to a program of research papers, a splendid opportunity is offered to discuss informally, routine problems and to exchange opinions and ideas regarding equipment and processes used in the industry. For this purpose informal gatherings are held at Wire Association Headquarters in the Hotel Cleveland which are open from 9 A. M. to 11 P. M., during the convention.

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Every wire mill production executive engaged in the manufacture or fabrication of wire and wire products of any kind is invited to join the Wire Association and attend these meetings.

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Make Your Plans Now to Come and Participate in the Discussions.

For detailed information address RICHARD E. BROWN, Secretary

THE WIRE ASSOCIATION

17 East 42nd St. **New York, N. Y.**

✣ PROGRAM ✣

Monday, October 19, 1936 at Hotel Cleveland, Ohio

A. M.—Registration—"Get Together"
1 P. M.—Directors' Meeting—Program Committee Meeting
3:30 P. M.—Annual Meeting of The Wire Association

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The Technical Sessions

TUESDAY, WEDNESDAY AND THURSDAY, OCTOBER 20-21-22, 1936

(All Research Papers Are Preprinted in the October Issue of Wire and Wire Products)

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THESE TECHNICAL SESSIONS AND INFORMAL MEETINGS

ADMISSION WILL BE BY BADGE ONLY

To those Registering and Attending the Meetings stenographic copies of the discussions will be available at $2.50 per copy
To all others $5.00 per copy

The Following Papers Will Be Presented and Open Discussions Held On The Topics Covered

A LIST OF QUESTIONS SUBMITTED FOR DISCUSSION ON THESE AND OTHER TOPICS WILL BE DISTRIBUTED IN ADVANCE AT EACH MEETING

✦ ✦ ✦

TUESDAY, OCTOBER 20, 1936
Morning Session—Hotel Cleveland—9:30 A. M.
Subjects—(a) Cleaning (b) Heat Treating (c) Material Handling

Frederick A. Westphal,
Superintendent, Wire Mills, Sheffield Steel Corp., Kansas City, Mo.
Chairman of Meeting

Paper:—Cleaning Houses In The Wire Industry

By A. F. Anjeskey, Sales Manager, Cleveland Tramrail Division, Cleveland Crane & Engrg. Co., Wickliffe, Ohio.

A discussion on cleaning houses, covering the layout of an ideal cleaning house from the standpoint of physical dimensions, type and arrangement of tubs, suggested method for storing and measuring acid, and type of materials handling equipment used, together with illustrations of the trend toward the installation of the straight line cleaning house.

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Paper:—Atmospheres and Furnaces In The Wire Industry

By H. M. Heyn, Engineer, In Charge of Heat Treating Div., Surface Combustion Corporation, Toledo, Ohio.

A paper dealing with atmospheres and furnaces in the wire industry. A recognition on the part of the wire producers of better metallurgical control and the many ramifications for exercising this control becomes apparent considering the many different analyses of steel required by the users of wire. This has necessarily called for better heat treatment.

The many advantages of the application of prepared gas atmospheres to process furnaces are apparent although each application must necessarily be decided after careful consideration is given to all of the factors entering into an intelligent determination of costs.

Controlled atmospheres necessarily do not apply only to prepared atmospheres. Automatic proportioning gas burning equipment, the carbon diffuser or atmosphere conditioner suffice for many applications. The necessity of better understanding the chemistry of prepared gas atmospheres, and the mechanics of application, become apparent when thought and study is given to the many variations that will result due to catalytic effect and other unbalancing conditions.

AFTERNOON SESSION—HOTEL CLEVELAND—2 P. M.

Subjects—(a) Springs (b) Welding Wire

R. B. Whyte, General Superintendent
The MacWhyte Company, Kenosha, Wisconsin,
Chairman of Meeting

Paper:—Materials For Springs

By J. W. Rockefeller, Jr.,
Consulting Engineer, New York, N. Y.

An analysis of various metals for springs including a discussion of music wire, annealed steel, hard wire, alloys—Cr.-V. Si-MN, etc., monel metal and phosphor bronze.

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Paper:—Welding Wire

By R. Notvest, Chief Engineer Welding Div.,
J. D. Adams Company, Indianapolis, Ind.

Mr. R. S. Simmons, General Metallurgist, Keystone Steel & Wire Company, Peoria, Illinois. has consented to assist the writer by discussing the paper from the view point of Open Hearth, Rolling Mill and Wire Mill practice.

Vital metallurgical characteristics of drawn wire to be used for arc welding electrodes. The author endeavors to show that the requirements are entirely different due to the superheating of the metal and quick freezing of the same when utilized as arc welding electrodes.

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Sound Motion Picture:—The Manufacture of Enduro Stainless Steel

Republic Steel Corp., Cleveland, Ohio.

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WEDNESDAY, OCTOBER 21, 1936

Morning Session—Hotel Cleveland—9:30 A. M.

Subject:—Research

R. S. Simmons, General Metallurgist,
Keystone Steel & Wire Co., Peoria, Illinois.
Chairman of Meeting

Paper:—Research As Applied To Manufacturing

By C. W. Meyers, Development Engineer,
American Steel & Wire Co., Cleveland, O.

✦ ✦ ✦

Address:—Development and Standardization of Types of Military Equipment

By Captain Frank W. Bullock,
Signal Corps., United States Army

Sound Motion Picture:—Signal Communications Within The Infantry Regiment

AFTERNOON SESSION—HOTEL CLEVELAND—2 P. M.

Subject:—Cold Working of Metal

Lewis H. Winkler, Metallurgical Engineer,
Bethlehem Steel Company, Bethlehem, Pa.
Chairman of Meeting

Paper:—Plastic Deformation In Wire Drawing

By B. L. McCarthy, Metallurgist,
Wickwire Spencer Steel Co., Buffalo, N. Y.

This paper is intended to present a picture of what occurs when metal is cold worked, and the various factors that interfere with the uniform distribution of cold working strains. While most of the specific examples relate to the drawing of steel wire, the same general principles can be applied to the non-ferrous metals and alloys from which wire may be drawn.

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EVENING—THE MAYFAIR CASINO—7:00 P. M.

Informal Dinner of the Wire Association

Ralph K. Clifford, President, The Wire Association, Toastmaster

✦ ✦ ✦

Award of The Wire Association Medal

By John C. Callaghan, Chairman of Program Committee

✦ ✦ ✦

DINNER COMMITTEE

A. R. Zapp, Manager
Firthaloy Division
Firth Sterling Steel Co.
McKeesport, Pa.

J. R. Morrison, President
Morrison Engineering Co.
Cleveland, Ohio
Chairman

R. L. Hamaker, Dist. Sales Manager
American Lime & Stone Co.
New York, N. Y.

✦ ✦ ✦

THURSDAY, OCTOBER 22, 1936

Morning Session—Hotel Cleveland—9:30 A. M.

Subjects:—(a) Testing Copper Wire (b) Power Cable (c) Power Requirements for Drawing Copper

Waldo L. Sherman, Secretary,
John Robertson Co., Inc., Brooklyn, N. Y.
Chairman of Meeting

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Paper:—Endurance Tests on Electrolytic Tough Pitch and Oxygen-Free Copper Wire

By J. N. Kenyon, Testing Engineer,
Instructor in Civil Engineering, Columbia University, N. Y.

While the endurance limit of copper has been fairly well established by tests by the rotating-beam method, there appears to be little or no endurance data on copper wire. Endurance tests on fabricated wire are important since—in the case of ferrous materials, at least—the usual commercial surface condition is, to a large extent, the controlling factor. In consideration of these facts, endurance tests on electrolytic tough pitch and oxygen free copper wire are being undertaken by the writer.

Straight lengths of 0.080″ diameter copper wire, both in the annealed and hard-drawn conditions, were selected for the investigation. The tests are being made by a stress reversal method known as the Rotating-Wire Arc Fatigue Machine. It appears, however, that some experimental work and a modification in the Arc method must be made, before satisfactory results may be obtained on soft annealed copper wire.

On the hard-drawn materials, tests have already been made up to 100,000,000 stress reversals, and probably 300,000,000 reversals will be necessary before a definite endurance limit can be established. Certain tentative conclusions, however, have been reached with regard to the hard-drawn materials:

(1) The Oxygen-Free material shows a somewhat higher endurance limit.

(2) The effect of the usual commercial surface condition on the endurance limit of copper wire is not so pronounced as in the case of steel wire.

THURSDAY, OCTOBER 22, 1936
Morning Session (Continued)

Paper:—Vacuum Lead Sheath As Applied To Power Cable

By R. W. Atkinson, Research Laboratory,
General Cable Corp., Perth Amboy, N. J.

Three or four years ago the industry realized that while cable insulation had been improved to such an extent that failures due to defects in the dielectric had been practically eliminated, the number of failures attributed to sheath troubles were actually increasing. As a result, widespread attention was directed on lead sheath to determine the nature of these failures and to discover means of eliminating them.

Metallurgical studies showed that the sheath did not have the homogeneous structure that had been fondly imagined but had very definite regions of weakness. The persistence of these non-homogenities was found to be largely a result of the presence of finely divided non-metallic inclusions (principally oxides, remnants of lubricating materials, or gas bubbles). Various methods of eliminating this condition were tried out or suggested. More careful skimming and better Foundry practice gave considerable improvement. The use of inert or reducing gas over the surface of the lead resulted in a marked reduction in the amount of oxide; and elimination of excessive lubrication reduced the troubles from this source.

With all these improvements, however, there continued to be a section of each charge length which contained more or less prominent flow lines when properly etched and showed mechanical weakness under certain test conditions. It occurred to us that the only complete solution was to keep the lead from contact not merely with oxygen but with any gas at all times after leaving the melting kettle. This has been accomplished by maintaining a high vacuum in the press cylinder and in the feed line to the press. At the same time the lubrication of the ram and cylinder walls between charges was of necessity eliminated. This method of Extrusion (termed the "vacuum" process) has made possible the complete freedom of pure lead sheath from all visible flow lines and from the regions of lower strength under the bending test characteristic of non-vacuum sheath.

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Paper:—Power for Cascade Drawing of Copper

By Paul M. Mueller, Mechanical Engineer,
Rome Division, Revere Copper & Brass, Inc., Rome, N. Y.

In answer to criticism that the published data on the drawing of wire is entirely theoretical or at least so involved that its practical application is lost, the author presents data covering the ranges of breakdown in intermediate drawing from which it is simple to calculate a given series of drafts for the various types of drawing equipment in general use.

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Motion Picture:—The Tactical Employment Of The Anti-Aircraft Artillery Regiment

A sound motion picture illustrating the use of anti-aircraft artillery and communication methods.

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AFTERNOON SESSION—HOTEL CLEVELAND—2 P. M.

Subject:—Dies and Tools

Kenneth B. Lewis,
Consulting Wire Mill Engineer, Worcester, Mass.
Chairman of Meeting

Paper:—Tungsten Carbide

By A. R. Zapp, Manager, Firthaloy Division,
Firth Sterling Steel Corp., McKeesport, Pa.

A study of the metallurgical characteristics of tungsten carbide and its application to dies and tools.

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Paper:—A Suggested Method of Handling Tungsten Carbide Dies Within The Die Room

By K. R. Beardslee, General Sales Manager,
Carboloy Company, Inc., Detroit, Mich.

This paper covers a suggested method of servicing tungsten carbide dies within the die run, outlining economies to be effected through proper handling and efficient service methods.

Whitehead Hill & Company Limited Reports Production of Galvanized Wire for High Quality Purposes

IN connection with an article which appeared in June on "Electro Galvanizing of Wire" by Arnold Weisselberg, the Editor is in receipt of a letter from Whitehead Hill & Company, Limited, Newport, Mon., England, asking us to call attention to certain changes in their processes which differ from those reported in that article. These changes are embodied in the following letter:

"The Editor,
Wire & Wire Products
Dear Sir:

In reference to the article appearing in your June Publication on Electro Galvanizing of Wire by Arnold Weisselberg, two or three references are made to our Plant at our Oakfield Works, Cwmbran. On one point we shall be glad if you will correct what is stated, and that is that our Galvanized Wire is not regarded as suitable for high quality purposes owing to the methods of cleaning not being satisfactory.

This was quite true for the first three years we took the plant over, but in 1928 it was entirely re-designed from being a single wire plant to three groups of 16 wires each. The whole process of Annealing, Cleaning and Galvanizing is entirely continuous, and has resulted in a very high class product, which is mainly sold for purposes where the best quality is required, such as in Cable Armouring, Post Office work, or where the wire has to be subjected to severe bending.

We are still the only Wire Manufacturers in this country who galvanize by this process, which has proved not only satisfactory in quality, but comparable in cost to modern hot galvanizing. More than one third of our wire production is galvanized by this means.

We trust in view of the statements you make in the article, you will give equal publicity to our comments.

Yours faithfully,
WHITEHEAD HILL & COMPANY LIMITED."

✦ ✦ ✦

WE are very glad indeed to make this correction for the benefit of the trade at large.

✦ ✦ ✦

Mile A Minute Measuring Meter For Wire and Wire Rope

THE Durant Manufacturing Co., manufacturers of the well known PRODUCTIMETERS, have just completed a new model which will prove of real interest to wire and rope manufacturers. This model, known as Model L-20, was designed to fill a long felt need for a meter capable of measuring wire and rope up to 1½" in diameter. This new unit combines speed, accuracy and ruggedness, and is actually capable of measuring wire and rope in feet at a rate of 5280 feet per minute.

A FEW of the outstanding features of the new Model L-20 are as follows:

- Double worm drive, ball-bearing counting unit
- Instantaneous circular brake
- Ball bearing, hardened measuring wheel
- Solid steel pressure wheel
- Double guides
- Capacity up to 1½" diameter measuring range

✦ ✦ ✦

BECAUSE of its flexibility and ease of installation, the Model L-20 Measuring Meter is admirably adapted to warehouse service as well as in the production plant. Complete information on this new model can be had by writing to the Durant Manufacturing Co., Milwaukee, Wisconsin. Ask for catalog section No. 3-A.

Come to Cleveland

by rail
by motor
by steamer
by air

and come to Cleveland's most convenient hotel

HOTEL CLEVELAND

• Without going out of doors from your train in the Union Terminal a red cap will bring you to the large, friendly lobby of Hotel Cleveland.

All principal motor routes pass our door on Cleveland's Public Square. A modern 2000-car garage adjoins Hotel Cleveland and can be reached by an inside passageway.

The palatial Great Lakes steamers and cruise ships dock a few minutes away from Hotel Cleveland.

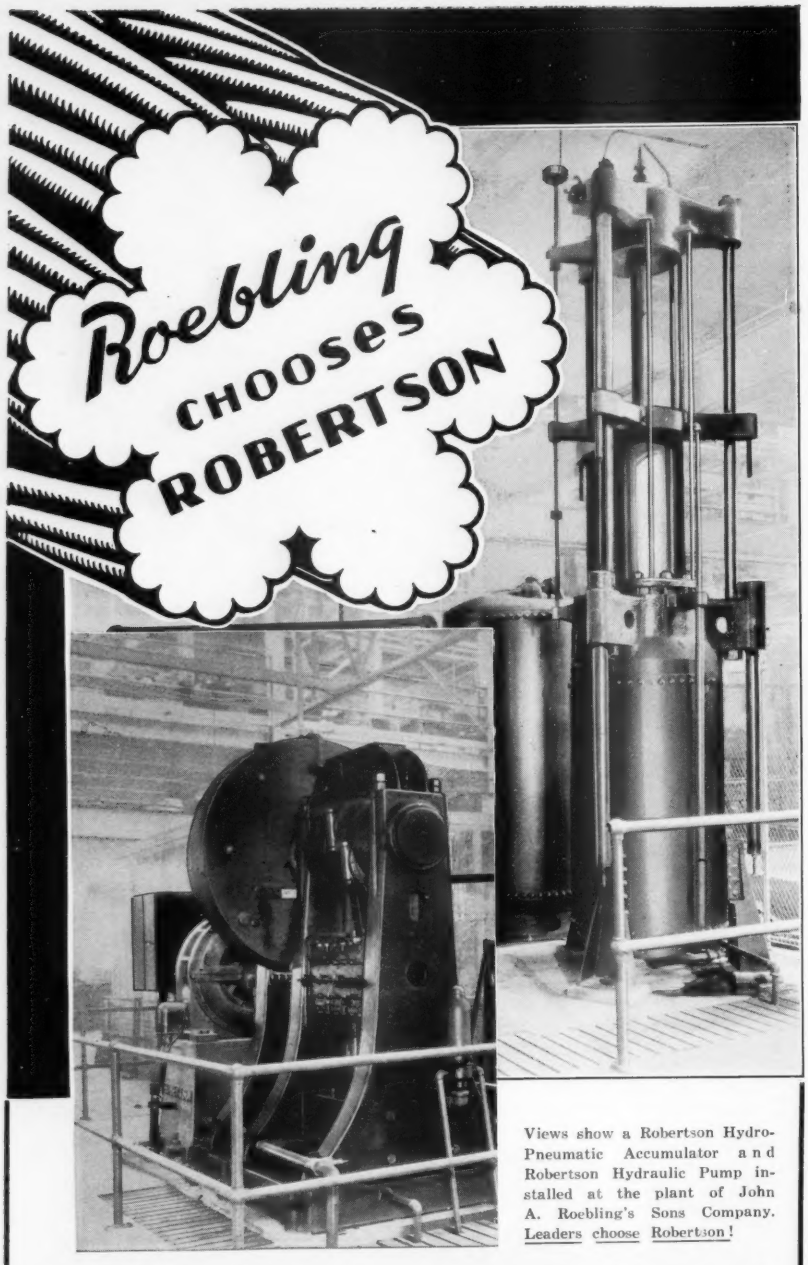
From the largest municipal airport in the world there is direct motor transportation at a small fixed charge to Hotel Cleveland.

However you choose to enter or leave Cleveland, you will find the convenient location, the hospitable welcome, the friendly attention you receive at Hotel Cleveland a pleasant memory of the city.

Rooms from $2.50 for one, $4 for two. Three restaurants and popular priced, air-conditioned Coffee Shop. Breakfasts from 25c, luncheons from 50c, and dinners from 75c.

HOTEL CLEVELAND Cleveland

MAKE YOUR PLANS NOW TO COME TO THE WIRE ASSOCIATION MEETING



Views show a Robertson Hydro-Pneumatic Accumulator and Robertson Hydraulic Pump installed at the plant of John A. Roebling's Sons Company. Leaders choose Robertson!

The Accumulator, as installed is for 1500-6000 lbs. hydraulic pressure and operates at only 175 lbs. air pressure. It is equipped with automatic auxiliary compressor which maintains pressure in the cylinder and storage tanks. And, because it utilizes its air tank as a base, it occupies an absolute minimum of floor space and requires no special heavy foundation.

The Robertson Hydraulic Pump has 14 separate construction features designed for greater endurance, dependability and efficiency under severe operating conditions. Precision built, it will give years of economical, trouble-free service.

Complete information on these, or any Robertson product upon request. No obligation.

John ROBERTSON CO. INC. Pioneers~Since 1858

125-37 Water Street Brooklyn, N. Y.

A Review of Recent Wire Patents

(*Continued from page 442*)

In this wire spring construction, it is stated that some of the stresses, imposed upon the spring intermediate the front and rear frame members, are transferred to the spring supported upon the frame members themselves.

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No. 2,047,736, INSULATED CONDUCTOR, Patented July 14, 1936 by Archie R. Kemp, Westwood, N. J., and Alvin N. Gray, Baltimore, Md., assignors, by mesne assignments, to Western Electric Company, Incorporated, a corporation of New York.

About the wire is a uniform layer of vulcanized insulating material, this material before vulcanization consisting of the following ingredients:—crude rubber 22.0%, reclaimed rubber 20.0%, mineral rubber 5.0%, whiting 44.7%, zinc oxide 2.5%, anti-oxidant 1.5%, sulphur 1.0%, pine tar oil 3.0% and ultra-accelerator .3%.

✦ ✦ ✦

No. 2,048,093, ROOFING NAIL, Patented July 21, 1936 by John C. Alpeters, Detroit, Mich., assignor to Crescent Brass and Pin Company, Detroit, Mich., a corporation of Mich.

Adjacent the head of the nail is a shoulder for seating a disk of special construction, the inventor claiming that the flow of water around the head of the nail is prevented by this shoulder and the specific shape of the disk.

✦ ✦ ✦

No. 2.048,271, CABLE AND METHOD OF PRODUCING SAME, Patented July 21, 1936 by William D. Lindsey, South Orange, N. J., assignor to Garrison Fire Detecting System, Inc., New York, N. Y.. a corporation of Delaware.

The wire core is adapted to become molten under certain temperature conditions and, above the core is an electricity-conducting sheath, with insulating material between the sheath and core.

✦ ✦ ✦

No. 2,048,341, WIRE NETTING LOOM, Patented July 21, 1936 by Alva L. Kitselman, Muncie, Ind., assignor to Indiana Steel & Wire Company, Muncie, Ind., a corporation of Indiana.

This inventor has provided a new form of loom for the manufacture of wire fabric, operating for economy in the manufacture of the fabric.

✦ ✦ ✦

No. 2,048,414, SPRING CUSHION STRUCTURE, Patented July 21, 1936 by Huot W. Sternberg, Westport, Conn., assignor to The Owen Silent Spring Company, Inc., Bridgeport, Conn., a corporation of Conn.

More specifically. this structure is for the back of chairs and the like and it is claimed that the wire springs will be retained in position against displacement vertically.

✦ ✦ ✦

No. 2,048,450, STRANDED CONDUCTOR, Patented July 21, 1936 by Heinz Horn, Nordenham, Germany, assignor to Norddeutsche Seekabelwerke A.-G., Nordenham, Germany.

The claims in this case are directed to the method of manufacturing re-entrant type stranded conductors.

No. 2,048,459, STAPLE MAKING MACHINE, Patented July 21, 1936 by Myrtha Moffett, Fresno, Calif.

With this machine, staples of the form shown in U. S. patent 1,903,830, dated April 18, 1933, may be produced.

✦ ✦ ✦

No. 2,048,552, METHOD OF MAKING RUST RESISTING METAL PLATED WIRE, Patented July 21, 1936 by Charles D. Johnson, Worcester, Mass., assignor to Johnson Steel & Wire Company, Inc., Worcester, Mass., a corporation of Mass.

To the iron wire is applied a coating of zinc-cadmium alloy, which contains approximately twice as much zinc as cadmium, after which the coated wire is passed through a bath of molten tin thereby producing on the wire a coating in the nature of a zinc-cadmium-tin alloy.

✦ ✦ ✦

No. 2,048,637, SPRING ASSEMBLY FOR UPHOLSTERY, Patented July 21, 1936 by Abraham N. Lisson, Lynn, Mass., assignor to Lisson-Melen Company, Lynn, Mass., a corporation of Mass.

With this assembly, the springs of one row are prevented from contacting or rubbing against those in the adjacent rows.

✦ ✦ ✦

Reissue No. 20,049, ART OF CONTINUOUS GALVANIZING, Patented July 28, 1936 by Julian L. Schueler, Kokomo, Ind., assignor, by mesne assignments, to C. W. La Porte, Peoria, Ill., and J. L. Schueler, Kokomo, Ind., trustees.

An apparatus is provided for continuous flame-treating the metal which has been freshly coated with molten galvanizing metal. The flames are projected angularly against opposed co-acting deflector surfaces for repeated rebound from one surface to another to produce a flame impingement upon the molten coating. It is claimed that, with this treatment, there is a uniform distribution and smoothing of the coating.

✦ ✦ ✦

No. 2,048,811, BUOYANT CABLE, Patented July 28, 1936 by Walter T. Peirce, Worcester, Mass., assignor to The American Steel and Wire Company of New Jersey, a corporation of N. J.

More specifically, the cable is one adapted for use as an antenna for submarine boats.

✦ ✦ ✦

No. 2,048,839, TACK MAKING MACHINE, Patented July 28, 1936 by Basil Pomeroy Cooper and James Norman Henshaw, Leicester, England, assignors to United Shoe Machinery Corporation, Paterson, N. J., a corporation of N. J.

The machine is adapted for the manufacture of tacks as set out in U. S. Patent 1,396,191, dated November 8, 1921.

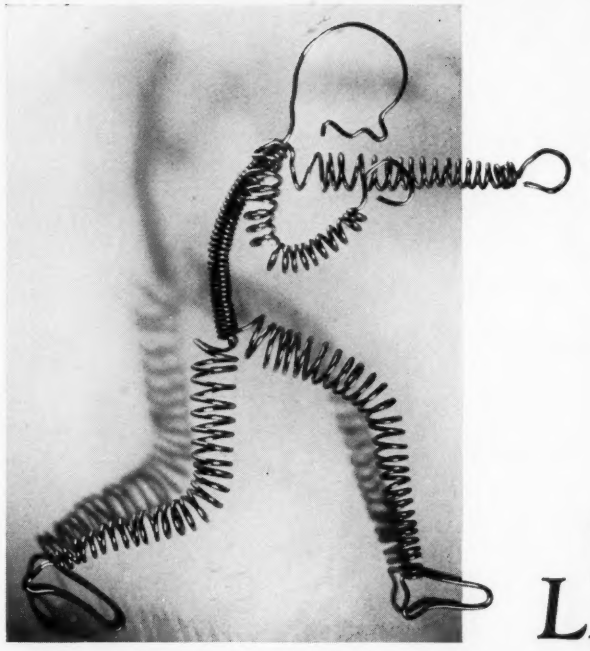
✦ ✦ ✦

No. 2,048,849, COVERED WIRE AND METHOD FOR PRODUCING THE SAME, Patented July 28, 1936 by Vito F. di Lustro, Irvington, N. Y., and Ellery W. Flansburg, Sycamore, Ill., assignors to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

The method comprises disposing several longitudinally extending bulky,

(*Please turn to Page 454*)

wire



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AND THE

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ALASTAIR T. ADAM, A.R.T.C.

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THE publication of the first edition of "Wire Drawing and the Cold Working of Steel" occurred over ten years ago, but in this age of technical development the progress made is so rapid that such a period is sufficiently lengthy to make any text-book out of date, and in the preparation of the second edition of this valuable work the author has not been so much surprised that much has had to be revised, or rewritten, as that any of the text could be left without modification.

✦ ✦ ✦

THE main scheme of the original edition has been retained with its intention of so presenting the subject that it may be of interest to both the wire manufacturer and the wire user. Some matter has been eliminated, but much has been added, notably an entirely new chapter dealing with typical applications of wire; and although some of the old text remains unaltered, every chapter has been completely revised and several entirely rewritten. The volume has also been re-illustrated with a large number of photographs, diagrams and tables. Thus has been brought fully up to date the author's intention to explain the real nature of cold-worked products, and to show how the physical properties required for a particular process may be obtained.

✦ ✦ ✦

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A Review of Recent Wire Patents

(*Continued from Page 453*)

fibrous bodies (such as cotton roving) about the wire, and then applying a strip longitudinally about the fibrous body, with an outer jacket about this strip.

✦ ✦ ✦

No. 2,048,850, WIRE COVERING MACHINE, Patented July 28, 1936 by Vito F. di Lustro, Irvington, N. Y., and Ellery W. Flansburg, Sycamore, Ill., assignors to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

This patent covers the machine for constructing the wire as set out in patent 2,048,849.

✦ ✦ ✦

No. 2,048,886, INSULATED CONDUCTOR AND METHOD AND MEANS FOR PRODUCING SAME, Patented July 28, 1936 by John W. Olson, Hastings-upon-Hudson, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware

A loose jacket, comprising strips of paper, is twisted about the wire conductor so that it will finally tightly enclose the wire with the strips crumpled where they overlap each other.

✦ ✦ ✦

No. 2,048,893, WIRE COVERING MACHINE, Patented July 28, 1936 by Paul M. Rogers, Orange, Calif., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Del.

The machine is particularly adapted for interconnecting relatively bulky wire strands with thin threads.

✦ ✦ ✦

No. 2,048,894, METHOD OF MANUFACTURING INSULATED CONDUCTORS, Patented July 28, 1936 by Samuel J. Rosch, Yonkers, and Vito F. di Lustro, Irvington, N. Y., and Paul M. Rogers, Orange, Calif., assignors to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Del.

The method comprises providing a web of loosely associated fibres, feeding a conductor horizontally in the direction of the length of the web, loosely draping the web longitudinally over the conductor and constricting it thereabout and wrapping a tape helically over the fibre encompassed conductor thus successively compressing and confining longitudinally extending areas of the web about the conductor.

✦ ✦ ✦

No. 2,048,979, SPRING CUSHION ASSEMBLY, Patented July 28, 1936 by Leonard Trotta and Hugo Perlesz, Chicago, Ill., assignors to Burton-Dixie Corporation, Chicago, Ill., a corporation of Delaware.

The individual wire springs are separately encased in a fabric casing arranged, according to the inventors, so that both the springs and the casings will hold their shape.

✦ ✦ ✦

No. 2,049,053, WIRE DRAWING MACHINE, Patented July 28, 1936 by Martin E. Evans, Kankakee, Ill.

The construction includes a spindle extending through and above the upper end of an upstanding shaft, having a drawing drum supported on its upper

end, both the projecting end of the spindle and the drawing drum thereon being above the top plate of the machine frame. It is stated that the spindle, by reason of this support to the drawing drum, relieves the pressure upon the top plate in consequence of the weight and operation of the drum.

✦ ✦ ✦

No. 2,049,073, CABLE, Patented July 28, 1936 by James J. Morrison, Worcester, Mass., assignor to The American Steel and Wire Company of New Jersey, a corporation of N. J.

The cable is particularly adapted for high-voltage use and includes a wire conductor with a shielding arranged in contact with the insulation around the wire, this shielding including relatively elastic strands having conductive wire wound thereon so that it is sufficiently elastic to accommodate distortion of the insulation.

✦ ✦ ✦

No. 2,049,187, APPARATUS FOR MAKING WIRE FABRIC SEAMS, Patented July 28, 1936 by Paul J. Abendroth and Otto A. Abendroth, Appleton, and Walter Wessenberg, Menasha, Wis.

The apparatus is adapted for joining the ends of wire fabric together and includes a pair of spaced clamps, each including a rigid bottom plate and a removable top plate, with a device, which is also removable, for supporting the free wire ends between the plates.

✦ ✦ ✦

No. 2,049,258, STRANDING MACHINE, Patented July 28, 1936 by Guy Gilbert Greene, San Francisco, Calif., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

In this wire stranding machine, there is provided the customary die, with a rotary wire feeder associated therewith and a periodically reversing drive for the feeder. In pulling the wires from the feeder through the die, there is provided a pass shaped to bend the wires beyond their elastic limit.

✦ ✦ ✦

No. 2,049,306, METHOD AND APPARATUS FOR TESTING FILAMENT WIRE, Patented July 28, 1936 by Louis L. Matson, East Cleveland, Ohio, assignor to General Electric Company, a corporation of N. Y.

The method and apparatus are particularly adapted for testing electric lamp filaments.

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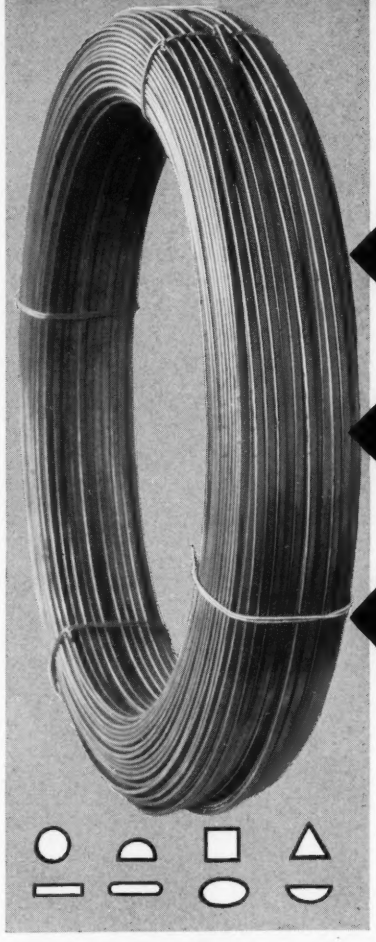

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Exports and Imports of Wire

(*Continued from page 441*)

square feet valued at $48,586), France (3,100 square feet valued at $6,062), Germany 1,480 square feet valued at $2,738), and Belgium (1,272 square feet valued at $1,910).

✦ ✦ ✦

WIRE cloth and screening imports (95,083 square feet) followed a decided upward curve in registering 38.2 percent higher than those for May, and came from Germany (57,507), Japan (15,006), the Netherlands (9,980), Canada (7,476), and the United Kingdom (5,112).

✦ ✦ ✦

THE import trade in **fourdrinier and other paper-making wire** (39,388 square feet) was at practically the same level as in the preceding month (40,823), the outstanding suppliers being Germany (17,273), Austria (7,838), France (7,751), and Sweden (5,395).

✦ ✦ ✦

IMPORTS of **wire heddles** (1,232,000 pieces) veered sharply upward to top the May trade by 67 percent, and were covered by Germany (710,000), France (270), and Switzerland (252).

✦ ✦ ✦

AN increased trade resulted in **wire fencing and netting,** galvanized before weaving, when the 100,275 square feet received—all from the Netherlands—reached 66.5 percent above the May total. Of the galvanized after weaving grade, 277,875 square feet came from Germany (199,126), and Belgium (78,750), which was considerably below (80 percent) the figure for the earlier month.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during June, 1936 totaled 15,095 gross valued at $3,147. Of this total Colombia took 3,546 gross valued at $708; Cuba 3,337 gross valued at $307; Argentina 1,934 gross valued at $910; Nicaragua 1,300 gross valued at $176; Mexico 958 gross valued at $201; Honduras 857 gross valued at $298; Netherland West Indies 680 gross valued at $69.

(*Please turn to page 464*)

Manufacture of Manila Rope Insulating Paper

(*Continued from page 438*)

ing as many as eighty pads threaded on a wooden dowel stick. The very thin and narrow papers are wound by Universal winding machines on spools known as cops.

✦ ✦ ✦

IT is obvious that the production of a tape of thin gauge paper perhaps .001″ thick by ⅛″ wide, capable of being wrapped fairly tightly around a copper wire at a speed of 5,000 revolutions per minute necessitates many refinements in the paper making process which cannot be covered by a brief account of this nature. We have endeavored simply to indicate a few of the high points in the conversion of a discarded Manila ship cable into a product so highly useful in the many phases of the electrical industry, including motors, switchboards, lamp cords, cables, meters and transformers.

✦ ✦ ✦

FROM start to finish, the product is subject to various control tests. Some of these are:

1. Chemical condition of stock in beaters.
2. Consistency of stock.
3. Water retention or degree of hydration.
4. Weight.
5. Gauge of finished paper.
6. Air resistance.
7. Bursting strength.
8. Tensile strength.
9. Tearing strength.
10. Percentage elongation.
11. Folding endurance.
12. Adhesion of plies.
13. "Formation".
14. Comparison of color with standard.
15. Comparison of finish with standard.
16. Percent ash.
17. Degree of acidity or alkalinity.

17a. pH of paper extract.

17b. Resistivity of paper extract.

18. Organic and inorganic water solubles.
19. Alcohol solubles.
20. Rate of oil absorption.
21. Stiffness.
22. Coefficient of friction.
23. Electrical tests as previously noted.

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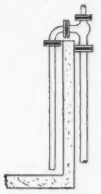
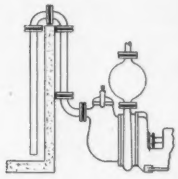


Self-priming Pump



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Steel for Arc Welding Electrodes

THE above is the title of a paper which will be presented before the Wire Association at its October meeting by R. Notvest, Chief Engineer, Welding Division, J. D. Adams Company, Indianapolis.

✦ ✦ ✦

THE paper will present comparative statistics of national consumption of mild steel electrodes for the month of June, 1932, 1935 and 1936, not only to show the general trend but also to prove that more tonnage goes now into electrodes than into rivets or bolts. This is followed by a brief and concise outline of the metallurgical process of transferring metal across the welding arc (that is changing the electrode material into fusion metal) proving through references and experimental data that in arc welding we have to deal with metal at a temperature close to its boiling point saturated also with metal vapors. This leads to a consideration of the "Ideal" arc welding electrode having

a. The correct chemical composition and a low impurity content
b. A low temperature resistance gradient
c. Minimum content of reactive gas producing monoxides

✦ ✦ ✦

THIS is followed by an analysis and evaluation of the two years' experience between the laboratory of Keystone Steel & Wire Co. and J. D. Adams Company, checking by means of the vacuum fusion method laddle metal, ingots, hot rolled rods and final drawn wire, and proving that the largest percentage of gas producing monoxides such FeO and MnO are incorporated into the metal through faulty technique in the rod mill and even during cold drawing.

✦ ✦ ✦

THE paper concludes with a brief review of pertinent and still valid U. S. Patents on chemical composition, metallurgical processing and mechanical shaping of electrodes for arc welding purposes, and winds up with a bibliographical reference list.

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New Requirements for Wire Insulation

"INDUSTRIAL Standardization" report in their July issue that three specifications for rubber insulation for wires and cables, submitted by the Sectional Committee on Wires and Cables were approved as American Tentative Standards as of June 2, 1936. Two are revisions of previous American Standards, while the third is a new specification. They are:

Code Rubber Insulation for Wire and Cable for General Purposes—C8.11-1936 (Revision of C8.11-1933).

Class A 30 Per Cent Rubber Insulaton for Wire and Cable for General Purposes—C8.4-1936 (Revision of C8d1-1928)[1].

Class AO 30 Per Cent Rubber Insulation for Wire and Caole for General Purposes—C8.17-1936.

✦ ✦ ✦

THE principal changes in the two revised standards other than those having to do with arrangement, corrections, classification of text, and other matters not involving specific requirements, are as follows:

✦ ✦ ✦

Code Rubber Insulation, C8.11-1936 (Revision of C8.11-1933)

THIS standard has always been based on the requirements for the rubber insulation in the Underwriters' Laboratories Standard for Code Wire. The following revisions bring it into agreement with the current (January, 1936) edition of that standard:

Reduction in wall thickness;
Elimination of rated voltages above 5000 volts;
Reduction in test voltages approximately in proportion to the reduction in thickness;
Slight increase in insulation resistance requirements;
Elongation test made simultaneously with the tensile test instead of with the permanent set test, thus conforming to what has now become standard work;
Addition of an accelerated aging test.

[1] Also AIEE Standard No. 63.

✦ ✦ ✦

IT is expected that with further general acceptance of the aging test, it will soon be practicable to eliminate the chemical requirements still retained in this standard, thus putting the material requirements on a performance basis rather than on chemical composition.

Class A 30 Per Cent Rubber Insulation, C8.4-1936 (Revision of C8d1-1928)

THIS standard corresponds to the rubber insulation requirements of the A.S.T.M. Standard for Wire and Cable Insulated with 30 Per Cent Rubber Compound. The following changes bring it into agreement with the current A.S.T.M. edition (D393-34T):

Change in rated voltage steps;
Reduction in wall thickness;
Elimination of rated voltages above 5000 volts;
Readjustment changes in test voltages —some up and some down.

✦ ✦ ✦

Class AO 30 Per Cent Rubber Insulation, C8.17-1936

THIS new standard corresponds to the insulation requirements in A.S.T.M. Standard A27-35T entitled "Insulated Wire and Cable: Class AO 30 Percent, Hevea Rubber Compound". The clauses with respect to thickness, chemical requirements, and electrical requirements are identical with those for Class A 30 Per Cent Compound (C8.4-1936) but the tensile strength and elongation requirements are somewhat higher. Also, there are two additional tests not in the Class A Standard; namely, moisture absorption and accelerated aging.

✦ ✦ ✦

THESE standards have all been approved as American Tentative Standards rather than as American Standards because it is anticipated that it will be practicable in the near future to simplify the existing situation with respect to a multiplicity of standards for rubber insulation for wires and cables. With the gradual acceptance by industry of the new rubber compounds with superior aging characteristics which have been developed in recent years, there is a growing opinion that there is no practical need for so many different classes of rubber insulation. This will be particularly the case when the new so-called performance type of compound has been sufficiently seasoned to warrant submission to ASA for approval.

(*Please turn to page 462*)

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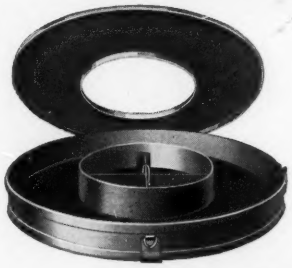

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✦ ✦ ✦

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✦ ✦ ✦

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Factors Affecting the Performance Of Springs

(*Continued from page 429*)

IT frequently happens that although a spring leaves the shop in perfect condition, the service conditions which it subsequently encounters are responsible for surface defects which shorten its life. The spring illustrated in Fig. 5 is such a case. This flat spring was used in an automotive part, in which its function was to absorb shock. This was accomplished by its acting as a buffer for a rotating square part and transmitting the rotation to other parts of the transmission. The sharp edge of the square part caused nicking of the spring at a point at which the maximum fibre stress occurred, resulting in a concentration of stress in the spring and premature failure of the part. When the spring was redesigned, the nicking action was made to occur at a point of zeron stress and failure of the spring was eliminated.

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IN designing certain types of springs such as valve springs, vehicle suspension springs etc. it is necessary to consider dynamic as well as static conditions, and in many such cases the period of vibration of the spring becomes important. In a straight helical compression spring, or a barrel type or conical compression spring so designed that all coils close at once we find ideal conditions for harmonic vibrations. Under such conditions the period of the spring is isochronic, which is to say that the period remains the same under all amplitudes. If, under such conditions, there is a regularly applied external force just large enough to more than offset the damping factors, and such application synchronizes with some of the lower harmonics of the sprung system, stresses in the spring, far beyond those calculated by static formulas may result and complete failure may ensue.

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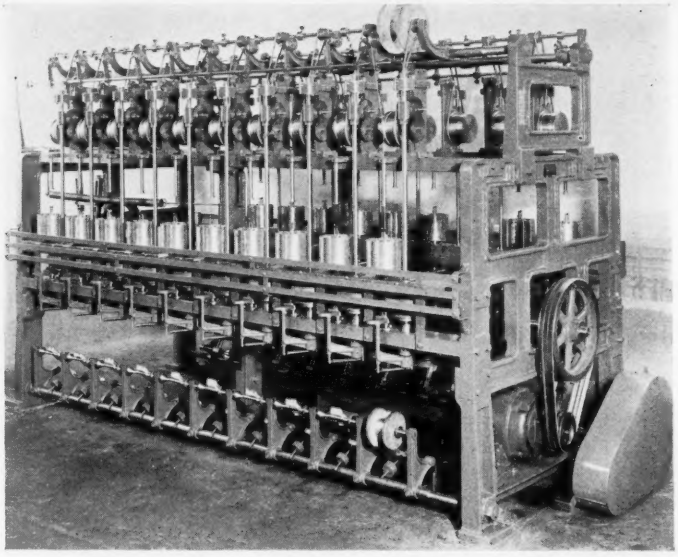
IN addition to considering the natural period of vibration of the sprung system, it is necessary to consider vibrations of much higher frequency traveling within the spring itself and frequently much more troublesome to the designer. In the case of valve springs these vibrations may be studied by the rotating disc or neon bulb stroboscope. Such studies reveal, that under certain conditions, there exists an uneven distribution of stress throughout the length of the spring, resulting in overstressing of some coils and under stressing of others to such extent as to prevent proper seating of the valve. Such a condition can frequently be cured by redesigning the spring to increase its stiffness and decrease its period of vibration (increase its frequency) to such a point that at ordinary running speeds of the engine there is no resonance at the lower harmonics. Fig. 3, illustrates some of the steps that have been taken to eliminate resonance in the case of valve springs by modifying the straight line load-deflection characteristic of the helical compression spring and eliminating isochronic vibration characteristics. In aircraft engine design, one manufacturer recently went to the extent of using leaf springs for valves, in order to introduce sufficient damping to overcome resonance conditions at critical speeds. However, helical wire springs can be made to operate satisfactorily in practically every case, provided the designer is acquainted with conditions. A stroboscopic study of valve springs in actual operation will often indicate that not only the frequency of application of the external force, but the rate at which it is applied is important, and oftentimes a modification of the cam contour is sufficient to eliminate spring breakage without making any change whatever in the design of the spring itself.

✦ ✦ ✦

IN vehicle suspension springs, a vibration damping element, in the form of a shock absorber is usually used in connection with helical springs to suppress har-

(*Please turn to page 463*)



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The Preparation and Microscopic Examination of Metallic Specimens

(*Continued from page 435*)

mermann (Archiv. fur das Eisenhüttenswesen, Vol. 4, p. 435, 1931) state that prints made on gelatin paper using the following solutions will reveal only sulphides, phosphides having no effect.

✦ ✦ ✦

TWO solutions are used, namely:

No. 1 Solution

25 gr. Cadmium Acetate
200 c. c. of 80% Acetic Acid, to this added
500 c. c. Sulphuric Acid dissolved in
950 c. c. Water.

No. 2 Solution

120 gr. of Copper Sulphate dissolved in
120 c. c. Sulphuric Acid added to
880 c. c. of Water (12% solution)

✦ ✦ ✦

THE specimen to be examined is pressed against gelatin paper for 1-4 minutes which has been treated with the cadmium acetate or number one solution. Yellow stains of cadmium acetate are formed on the paper.

✦ ✦ ✦

THE paper is then immersed in solution number two for two to three minutes which changes the stain to black copper sulphide.

✦ ✦ ✦

END OF PART II

Part I—Method of selecting sample, cutting the specimen, mounting and polishing the specimen, was published in August.

Part III—Results obtained from the microscopic and macroscopic examination of metals will be published in the November issue.

New Requirements For Wire Insulation

(*Continued from page 459*)

IT will be noted that these standards are all limited to 5000 volts rated circuit voltage. It is the opinion of the committee that rubber insulation for high voltage applications should be covered by separate specifications. Such specifications are in the course of development and they will apply to voltages above 5000 volts.

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Factors Affecting the Performance of Springs

(*Continued from page 461*)

monics, in railway truck design, leaf springs are frequently used in combination with helical springs. Such combination not only introduces a damping factor but results in a sprung system the period of vibration of which is not isochronic.

✦ ✦ ✦

IN instrument design, vibrations are not ordinarily troublesome as a cause of spring breakage but are undesirable because of their tendency to prevent a quick reading of the instruments being taken. In such cases damping is frequently introduced in the form of an oil or graphite dashpot or, in rare cases, by magnetic damping. It is important to such cases, of course, that the damping be such that the accuracy of the instrument is not affected thereby.

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Effect of High Temperatures on Springs

AS temperatures higher than those of the ordinary atmosphere are encountered by springs the effect on many of their properties becomes marked. The effect of high temperatures upon the modulus of elasticity, creep and hysteresis will be dealt with more fully in discussing instrument springs, for it is upon this type of spring where such effect is more frequently a problem.

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IN the case of many spring materials, temperatures above normal tend to raise the fatigue properties provided the rise in temperature does not exceed well defined limits. Regarding the property of a spring to exert a given force for prolonged periods abnormally high temperatures are a factor to be considered in this regard. Generally, a spring exposed to elevated temperatures will lose its strength in this respect as the temperature is increased, some metals being considerably more affected than others. and often the extent to which the material is stressed has an important bearing on the degree to which it is thus affected. Music wire, that material which in many cases is considered to have the very best properties for wire springs is greatly affected at all stresses above temperatures of 200°F. At low stresses tempered carbon steel may be safely used up to temperatures of 400°F., while high speed steel may be used safely at temperatures that would be excessive for other metals. Limited tests have indicated that this material can be used at stresses of 40,000 lbs. per sq. in. up to temperatures above 600°F. without marked loss of strength. Chromium and nickel steels show promise as useful spring materials under elevated temperatures. Some of the stainless variety of chromium steels appear to rival high speed steel in this respect. It will be noted that in many cases a material of lower tensile properties at ordinary temperatures is more suitable for use where high temperatures are to be encountered and where high temperatures are accompanied by a corrosive atmosphere, as is often the case, some non-ferrous alloy such as monel metal may be the material which will give the best service in springs to be used under such conditions.

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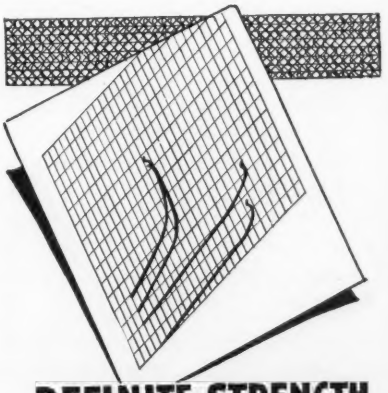

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Investigations in Film Lubrication

AMONG the papers to be presented at the next meeting of the Institution of Mechanical Engineers of Great Britain is one entitled "Investigations in Film Lubrication" by A. S. T. Thomson, Ph.D., G. I. Mech. E., Lecturer in Mechanical Engineering, Royal Technical College, Glasgow.

✦ ✦ ✦

THE main section of the paper describes an experimental investigation of the operating conditions of centrally loaded clearance journal bearings carried out on a new testing machine fitted with a 2.5-inch diameter shaft. Nine bearings were investigated, comprising three arcs 180, 90, and 60 deg., and three lengths, 4, 2, and 1 inches, for each arc. The results for any one bearing can be represented by single curves drawn on a base of the criterion Zu/P, where Z is the absolute viscosity, u the surface speed, and P the load per unit length. The curves indicate that decrease in length or arc of embrace lowers the load capacity per unit length and that increased end leakage raises the value of the cofficient of friction. The journal displacement diagrams show a decrease in horizontal displacement with bearing arc or length, and indicate, in certain cases, that the journal centre may rise above that of the bearing. The distribution of film pressure over the surfaces of the nine bearings is investigated for eccentricity ratios ranging from 0.5 to 0.95. These curves illustrate the change in form of the pressure curve, and the curtailment of the effective bearing arc as the eccentricity ratio increases.

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THE results of the complete investigation are compared with recent experimental and theoretical work, and expressions and curves are developed which might serve as a guide in bearing design.

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TWO short sections precede the main subject matter of the paper. The first constitutes a summary of an investigation on the operating conditions of a 4-inch by 2.5-inch 120. deg. bedded brass

Numerous readings were taken in the transitional region between boundary and film lubrication. The results illustrate the unsuitability of bearings having large bedded arcs for operation under fluid friction conditions. The second short section deals with experiments on a Deeley friction machine and shows the effect on the boundary friction of the addition of colloidal graphite to a mineral oil, and the relative merits of various surface treatments with colloidal graphite.

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Exports and Imports of Wire

(*Continued from page 456*)

EXPORTS of brass wood screws during the same period amounted to 3,435 gross valued at $1,740. Of this total Argentina took 1,500 gross valued at $376; Cuba 600 gross valued at $241; Netherland West Indies 356 gross valued at $85; United Kingdom 345 gross valued at $400; Mexico 164 gross valued at $83.

✦ ✦ ✦

IMPORTS of wood screws during the same period amounted to to 32,691 gross valued at $2,387, of which amount Japan supplied 21,166 gross valued at $1,604; Sweden 8,350 gross valued at $597 and Germany 3,175 gross valued at $186.

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✦ ✦ ✦

"Ross Industrial Ovens"

"ROSS Industrial Ovens" is the title of bulletin No. 123 issued by the J. O. Ross Engineering Corporation, New York, N. Y., manufacturers of industrial ovens, oil and gas-fired heaters, and heating, drying and ventilating equipment. This bulletin contains detailed information as to methods of heating, the construction and methods of installation of the ovens, the material handling plan of the ovens, and an excellent description of the forced convection method of heating.

✦ ✦ ✦

A COPY of this bulletin may be obtained by addressing the Editor, WIRE AND WIRE PRODUCTS.

✦ ✦ ✦

New Bulletin of Kjeldahl Equipment

BULLETIN 151 just issued by the Precision Scientific Company, 1736-1754 N. Springfield Avenue, Chicago, Illinois, covers their complete line of Kjeldahl equipment for digestions and distillations, of the type that is used for nitrogen and protein determinations.

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Index to Advertisers

A

American Chemical Paint Co. 464
American Insulating Machinery Company 461
American Lanolin Corp. 462
American Lime & Stone Co. 457

B

Balloffet Diamond Wire Dies Co., Inc. 463
Broden Construction Co. 465

C

Carolina Crest Hotel 459
Carboloy Company, Inc. 409
Cleveland Tramrail Div. of The Cleveland Crane & Eng. Co. 444
Cochaud Wire Die Corp. 465
Continental Steel Corp. 455

D

Davis Electric Co., R. L. 460
Driver Harris Co. 463
Durant Manufacturing Co. 461
Duriron Company, Inc., The 457

E

Electric Furnace Co., The ..... Back Cover
Elevator Supplies Co., Inc. 410

F

Firth-Sterling Steel Company 422

G

Glader Machine Works, Wm. 445

H

Hallden Machine Company, The 465
Hudson Wire Company 412

J

Jagielski, Otto F., ... 465
Jones and Laughlin Steel Corp. 419

K

Kelly Wire Die Corp. 465
Keystone Steel & Wire Co. 453

L

Lancaster, Allwine & Rommel 462
Lewis, Kenneth B. 465

M

Manning, John A., Paper Co., Inc. 460
Meaker Company, The 415
Micro Products Company 441
Miller, R. H. & Co. 462
Morgan Construction Co. 417
Morrison Engineering Co. 443
Mossberg Pressed Steel Corp. 459

N

National Metal Congress 414
Norton Company 456

P

Parkin Co., Wm. M., The 464
Pittsburgh Steel Co. 416
Platt Bros. & Co., The 465
Polk & Co., R. L. 464

R

Republic Steel Corporation 413
Robertson Co., Inc., John 452
Ruesch Machine Company, H. J. 465

S

Schuyler, W. A. 465
Scott Company, Henry L. 463
Scudder Foundry & Machine Co., E. J. 465
Shuster Co., F. B., The 465
Sleeper & Hartley, Inc. 462
Spowers, W. H. Jr. 465
Syncro Machine Company 442

T

Thomson-Judd Wire Machinery Co. 465
Twitchell, E. W., Inc. 465

U

Union Wire Die Corp. 420

V

Vanadium-Alloys Steel Co. 421
Vaughn Machinery Co. ..... Front Cover
Vianney Wire Die Works 456

W

Watson Machine Company, The ..... Third Cover
Wheeling Steel Corp. 411

Y

Youngstown Sheet and Tube Co., The ..... Inside Front Cover

BUYERS' GUIDE

For more complete information, consult the annual Directory, Index & Buyers' Guide.

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New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire—
Syncro Machine Co., Newark, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Davis, R. L., Electric Corp., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis., and Providence, R. I.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Special—Combination Machine for Drawing, Cutting-to-length, Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

BUYERS' GUIDE, Continued

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
R. L. Davis Elec. Co., Wallingford, Conn.

MACHINERY—Testing Wire
Henry L. Scott Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Elevator Supplies Co., Inc., Hoboken, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MONORAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Annealing or Drying
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

PICKLING—Tank Linings
American Hard Rubber Co., New York, N. Y.

POTS—Annealing, Case Hardening and Tempering
Lindberg Engineering Co., Chicago, Ill.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Impregnating
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Superior Sheet Steel Co., Canton, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

SPOOLS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—Wire
Henry L. Scott Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Co., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel and Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

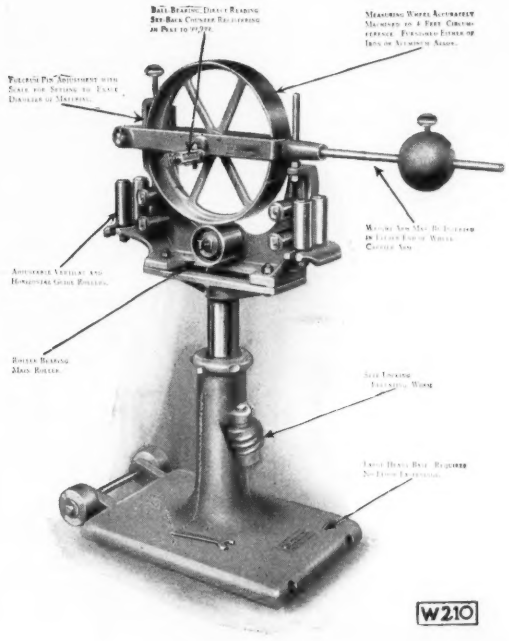
ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

ENGINEERS - FOUNDERS - MACHINESTS

WIRE MEASURING MACHINES

Our Standard for years and still in demand



Made in two sizes: DC-2 for diameters up to 1″, and DC-3 for larger diameters up to 3″.

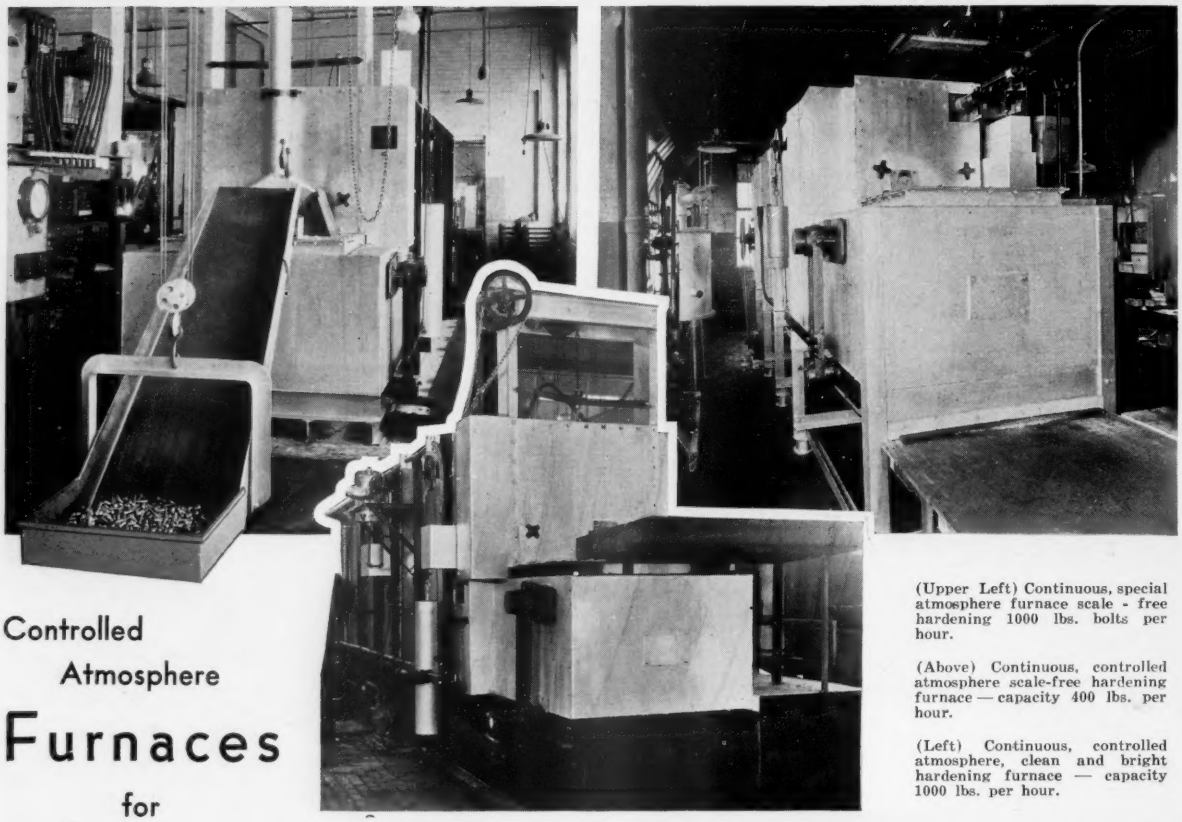
Three types of Measuring Wheels: Hardened Steel for galvanized and hard surface wires; Semi-steel for bare wire; and Aluminum for covered wire.

Machines furnished without Floor Stands for table mounting.

Smaller Measuring Machines, suitable for wires below ½″ diameter, also manufactured—ALL SIZES CARRIED IN STOCK.

Send for bulletin for full details.

ELECTRICAL WIRE AND CABLE—WIRE ROPE AND CORDAGE MACHINERY



(Upper Left) Continuous, special atmosphere furnace scale - free hardening 1000 lbs. bolts per hour.

(Above) Continuous, controlled atmosphere scale-free hardening furnace — capacity 400 lbs. per hour.

(Left) Continuous, controlled atmosphere, clean and bright hardening furnace — capacity 1000 lbs. per hour.

Controlled
Atmosphere
Furnaces
for

SCALE-FREE HEAT TREATING

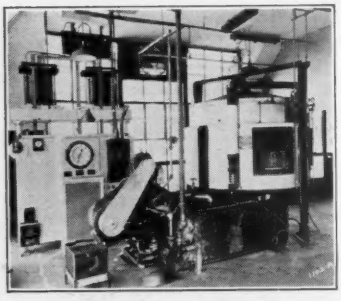
Bolts, Springs and Other Small and Medium Size Products---Continuously

FOR over seven years we have been building continuous chain belt conveyor furnaces. These furnaces are outstanding for their rugged, dependable conveyor construction and for their uniform, economical heat treatment of miscellaneous small and medium size parts and products.

This same type furnace is now being built for use with controlled atmosphere for scale-free heat treating and clean and bright hardening miscellaneous finished parts and products. Three of these furnaces are shown above.

The scale-free heating of material—particularly threaded parts, such as bolts and screws—allows for closer manufacturing limits than previously possible, and has resulted in a superior product at no appreciable increase in cost. The several installations made are showing rather remarkable results.

We will be glad to send data on this type or on furnaces for any other process in which you may be interested.



Small rotary hearth type special atmosphere furnace — with this furnace the handling of small quantities of small and medium size products such as bolts, springs, etc., is also placed on a continuous and economical basis.

Other outstanding controlled atmosphere installations include continuous furnaces for copper brazing, and bright and clean annealing stampings, tubing, wire, sheet, strip and other ferrous and non-ferrous products. We specialize on building fuel-fired and electric furnaces to fit the customer's requirements and will be glad to work with you on any of your furnace problems—for any process.

THE ELECTRIC FURNACE CO.
SALEM, OHIO.

Fuel-Fired Furnaces

Electric Furnaces